# Excavations at Spirit Cave, North Thailand:

## SOME INTERIM INTERPRETATIONS

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### INTRODUCTION

#### *Organization and Aims*

During 1965 and 1966 I conducted an archaeological field survey and excavations in northern Thailand. This research was coterminous with, and a continuation of, the University of Hawaii's Southeast Asian Prehistory program under the direction of W. G. Solheim II (Solheim 1966: 8–16; 1968: 39–41). The research was sponsored by the Fine Arts Department of the Thai government and the University of Hawaii Department of Anthropology. The field research was funded by a U.S. National Science Foundation Predoctoral Research Grant (GS-861), and a field subsistence grant was provided by the Mosher Fund for Southeast Asian Archaeology. Fieldwork began in October 1965 and ended in July 1966. From October 1965 until May 1966 I conducted archaeological surveys in selected areas of northern Thailand; June through July 1966 were spent excavating Spirit Cave.

*Aims*

The research proposal submitted to the National Science Foundation included the following specific aims:

1. to continue and expand the University of Hawaii–Thai Fine Arts Department's survey work then (and still) underway in Thailand, in order to

2. locate sites which would aid in establishing a local sequence in at least one section of Southeast Asia, which would

3. provide data regarding specific Southeast Asian cultural readaptations, if any, necessitated by the "presumptive climatic amelioration" (see White n.d.: 4) generally associated in other areas with the end of the Pleistocene. Southeast Asian assemblages thought to fall

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within this period are now placed under the general and ill-defined term "Hoabinhian." Then from these data to

4. examine the hypothesis long suggested by geographers (primarily) and botanists (de Candolle 1908; Ames 1939; Sauer 1948, 1952; Vavilov 1949–1950; Burkill 1952; Anderson 1960; Harlan 1961; Zukovskij 1962; Stern 1965; Harris 1967; etc.), arguing for the importance of the humid tropics as hearths of early plant and animal domestication. This position, based on relatively independent, nonarchaeological data, strongly indicates that the earliest steps toward agriculture were most likely taken in the Old World tropics (see especially Harris 1967: 107; Anderson 1960: 72). A general archaeological disregard for this position is reflected in D. Harris's recent statement (1967: 106): "The importance of Southwest Asia and Middle America as centers of early agriculture has been amply demonstrated, but the wealth of evidence from these areas has tended to obscure the potential significance of other parts of the world." Harris then lists Southeast Asia as one of the areas most likely to repay close botanical and archaeological study.

While the first two aims integrate this research with the larger University of Hawaii program, I consider that the last two aims constitute the major problem-oriented aspect of this particular research. Southeast Asian data regarding terminal Pleistocene-Early Recent cultural adaptations are conspicuous by their absence. A general term, Hoabinhian, often used in quotation marks, has been applied to a presumed widespread mesolithic, archaeological culture supposedly occurring in Southeast Asia during that time period. In the background to this research (below) I discuss the formulation and more recent definitions of the Hoabinhian. Further, I suggest a new, and I feel more meaningful, use of the term.

## *Background*

In 1932 at the First Congress of Prehistorians of the Far East, in Hanoi, the "Hoabinhian" was divided into 3 substages, and the term was first defined (see Matthews 1968: 86 for a translation of this first presentation). This definition was based on the well-known work of Madeleine Colani in the Hoa-binh region of what is now the Democratic Republic of Vietnam. Colani investigated 20 sites, describing 9 of these in her 1927 report, *L'Age de la Pierre dans la Province de Hoa-binh (Tonkin)* (Colani 1927). The many articles resulting from this fieldwork have recently been translated and reviewed in excellent detail by Matthews (1964; 1968).

H. R. van Heekeren (1957: 67–115) has summarized Hoabinhian finds in Indonesia where they appear to be confined primarily to the northeast coast of Sumatra (van Heekeren 1957: 67 and Fig. 13). Hoabinhian artifact types appear rarely in Java, but van Heekeren (1957: 74) contends that they represent late contact between the islands. A. Dani (1960: 105–226) has collated most of the pertinent literature on the Hoabinhian from Indo-China, Thailand, Malaya, and Burma. Each site is described, and artifacts are discussed and illustrated. Dani has presented a very good review of the literature, but has been able to do little more than furnish a new literary version of Colani's material (Dani 1960: 224).

Numerous other Hoabinhian sites have been excavated in Malaya (Matthews 1961), and two of these have yielded radiocarbon dates (Dunn 1966: 352–358).

The Thai-Danish prehistoric expedition in Thailand has excavated two stratified Hoabinhian shelter sites: Sai-Yok (van Heekeren and Knuth 1967) and Ongbah Cave (Sørensen 1969, personal communication). During 1960 and 1961, P. I. Boriskovsky investigated caves and shelters in the Hoa-binh region, and although little new information has been published, the test excavations support Colani's description of the Hoa-binh inventory (Boriskovsky 1967, 1968; Solheim 1962).

On the basis of the present knowledge of Hoabinhian assemblages, several writers have attempted to show that associated technological traits have spread to outlying areas; for example, to Japan (Maringer 1957: 3) and into Australia (McCarthy 1940; Matthews 1964, 1966). Others (Dunn 1970; Golson, forthcoming; Solheim 1967, 1969; and Matthews 1968) have focused attention on cultural developments within Southeast Asia and, in particular, on the importance of understanding just what is meant by "Hoabinhian," and what socio-cultural correlates were associated with this assemblage. Matthews has recently (1968: 94) attempted to redefine Hoabinhian (though still using it in quotes). Limiting himself to the Vietnamese material, he would call it a mesolithic culture that exhibits no evidence of agriculture and would ascribe to it a post-Pleistocene date.

F. I. Dunn (1970) reconstructs an early (11,000 B.P. to 5000 B.P.) *Conservative Areal Tradition* keyed to mainland Southeast Asia, which he correlates with a "Hoabinhian-like" chipped stone tool tradition. A genetic model is presented to explain mainland-island dissimilarities, which is extremely interesting when linked to the "founder principle" and early cultural diffusion.

J. Golson (forthcoming) combines the old "age-area principle" with the "founder principle" in a conceptually similar, though independently derived, reconstruction. He suggests a back dating of the Hoabinhian (Golson, forthcoming: 13) and argues for a terminal Pleistocene date for Southeast Asian horticultural origins within the Hoabinhian cultural context (Golson, forthcoming: 26). W. G. Solheim concurs with this late Pleistocene date for the Hoabinhian and would also include pottery manufacture and plant domestication within Hoabinhian contexts (Solheim 1967: 7; 1969: 130–131).

Dunn, Golson, and Solheim all suggest a late Pleistocene date for the beginning of the Hoabinhian; Matthews, on the basis of the Vietnamese evidence, still considers the Hoabinhian to be post-Pleistocene and therefore "mesolithic" (Matthews 1968: 94). I believe the concepts inherent in the "lithic" ages (paleo, meso, neo, etc.) are not valid for Southeast Asia (nor would I now use this model in any other part of the world; cf. Daniel 1965: 245). The Pleistocene-Recent boundary appears to have been ecologically insignificant in the Southeast Asian humid tropics; no major cultural readaptations were necessitated, and plants appear to have been domesticated in the terminal Pleistocene by people using a flaked tool technology (Gorman 1969: 673).

### *The Emergence of a Pattern*

At this point there does begin to emerge a pattern; the very nebulous Hoabinhian of Southeast Asia is now assuming a distinct geographical character and extends back into the terminal Pleistocene. Though new distributional and chronological data may cause revision, I think we should now address the terminological problem of what we mean by the term Hoabinhian. Dunn (1970) has suggested that the Hoabinhian be treated as a tradition as defined by G. R. Willey and P. Phillips (1958), and Matthews (1968: 94) has treated it as an archaeological culture. Given the area over which Hoabinhian sites occur, I doubt whether the sites are the remains of any single cultural group; the area from North Vietnam to Sumatra today includes very diverse cultural groupings and undoubtedly it did so in the past. Just how similar the present is to the past in Southeast Asia remains to be illuminated through hard archaeological data. However, the main attributes used to link these sites under the general term Hoabinhian are few indeed. Key traits include:

1. a generally unifacial flaked tool tradition made primarily on water rounded pebbles and large flakes detached from these pebbles;

2. core tools ("Sumatraliths") made by complete flaking on one side of a pebble (Pl. II) and grinding stones also made on rounded pebbles (Pl. II), usually in association with iron oxide;

3. a high incidence of utilized flakes (identified from edge-damage characteristics);

4. fairly similar assemblages of food remains including remains of extant shellfish, fish, and small and medium-sized animals (see Solheim 1969 and Gorman n.d.);

5. a cultural and ecological orientation to the use of rock shelters generally occurring near fresh water streams in an upland karstic topography (though Hoabinhian shell middens do indicate at least one other ecological orientation);

6. edge-grinding and cord-marked ceramics occurring (though perhaps as intrusive elements), individually or together, in the upper layers of Hoabinhian deposits.

These attributes are well established from Hoabinhian sites over the larger parts of Mainland Southeast Asia. The fact that they are distinctive and generally have been found in association has led to a general acceptance of the usefulness of the term. The question now is what level of sociocultural integration is implied in the term.

### *Redefining the Hoabinhian*

The Hoabinhian has been difficult to define, in part, I believe, because of the lack of conceptual categories of sufficient magnitude to cover such long-lasting and widespread characteristics. David Clarke has recently presented and defined just such a conceptual category, the technocomplex (Clarke 1968: 321–357):

> TECHNOCOMPLEX. A group of cultures characterized by assemblages sharing a polythetic range but differing specific types of the same general families of artefact-types, shared as a widely diffused and interlinked response to common factors in environment, economy, and technology. (Clarke 1968: 357)

Clarke (1968: 329) has used this term to "... unite heterogeneous groups of otherwise varied linguistic and sociocultural alignments." On occasion a large cultural group with good internal communication and a strongly individual ecological adaptation may form a single technocomplex (Clarke 1968: 329). Assuming that the cultural diversity now evident in Southeast Asia is not a new characteristic (and this may be arguable), I suggest that the wide distribution of Hoabinhian traits reflects an early Southeast Asian technocomplex, widely diffused and reflecting common ecological adaptations to the Southeast Asian humid tropics. This Hoabinhian technocomplex first appeared during the late Pleistocene and continued as a recognizable complex until ca. 6500 to 5000 B.C. (see radiocarbon chronology, tables 1 and 2). During the span of its "time-trajectory" (Clarke 1968: 33) the Hoabinhian technocomplex changed to include early plant domestication, edge grinding and cord-marked ceramics (plant domestication appears to represent an internal development; edge grinding and ceramics may be either internal or external developments).

The history of archaeological research in Southeast Asia has been one of isolated research over a wide area, concerned mainly with lithic (and occasionally faunal) remains from cave occupations. Because of this historical situation, specific "cultural groups" (Clarke 1968:

320) or archaeological cultures have yet to be identified. What has emerged is the larger entity, the technocomplex. With the Hoabinhian thus defined, I will define the Spirit Cave assemblage (Layer 5 through Layer 2) as a subcultural assemblage of the Hoabinhian technocomplex. Whether this represents a regional (Clarke 1968: 276) or an occupational sub-culture (reflecting a specific upland or seasonal exploitative pattern) remains to be determined.

## Northwest Thailand: Present Environment and Inferences into the Past

I describe, briefly, the geographical and geological characteristics, climate, soils, flora, and fauna of northern Thailand to provide an environmental background against which to examine the Spirit Cave assemblage. This is done in the hope of illuminating selective factors present in the cultural-ecological orientation of the Spirit Cave inhabitants.

### *Geographic-Geological Characteristics*

The site reported on in this paper is located in the northwest Thailand province of Mae Hongson. Spirit Cave (approximately lat. 19° 34′ N by long. 93° 7′ E) is situated between 600 and 700 m above mean sea level in a limestone cliff face overlooking the valley of the Khong Stream (Fig. 1). The valley floor is approximately 400 m above mean sea level; ridges in the vicinity of the shelter complex approximate 1,500 m with occasional peaks exceeding 1,900 m. The villages closest to the site, which are located in the Shan (Thai-yai) area of Thailand, are Mai Sang Nam and Mae Suya.

The major geological substratum over most of this area is composed of the Kanchanaburi sandstone series of Carboniferous, Devonian, and Silurian origin (Brown et al. 1953). Owing to intense seasonal monsoon rains, this series has been severely weathered, and alluvium has been deposited on the narrow valley floors or carried south to the larger lowland alluvial plains. In the small upland valleys, occasional plains have been formed by quaternary alluvial terrace deposits.

A second geological substratum occurring in a series of north-south oriented deposits is composed of Kamakala limestones of the Korat series, primarily of Triassic and Jurassic origin. Less frequent are isolated limestone outcrops of the Ratburi series of Carboniferous and Permian origin and the Thung Song limestone of Ordovician origin. These three limestone deposits have in many places become completely denuded, forming the characteristic "karst" topography common to older limestone areas. Percolation of heavy rains through these limestone strata has resulted in the formation of numerous cave and rock shelter formations. The Spirit Cave complex is one such formation.

### *Climate*

The climate of northern Thailand is designated an Agw climate by W. Köppen (1931) and a V3 tropical wet and dry climate according to C. Troll (1965); the spring and summers are hot and the winters are warm (Küchler and Sawyer 1967: 284–325). In general, the year can be divided into a hot dry season from March to May, a rainy season from May to October, and a cool dry season from November to February.

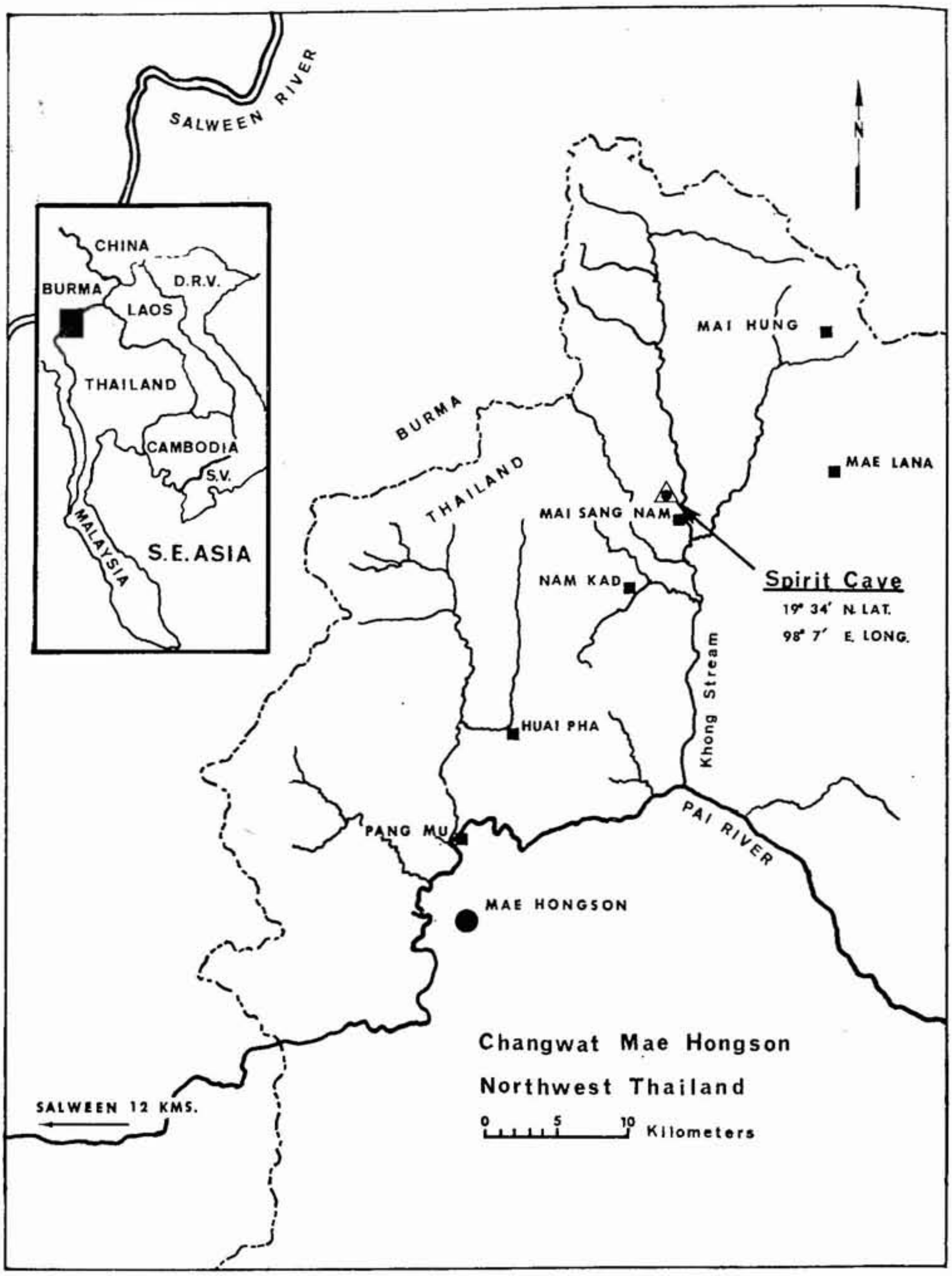


Fig. 1 Spirit Cave site location, northwest Thailand.

In northwest Thailand the monsoon pattern is continually modified by localized pressure variations. The north-south oriented mountain ranges form partial barriers to the monsoon winds creating local orographic variations, such as decreased rainfall on the leeward sides of the ranges. The temperature, precipitation, humidity, and wind velocity vary with topographic features and mean altitude.

The broad climatic characteristics of northern Thailand have been compiled by N. Y. Nuttonson (1963: 13):

annual precipitation 48 to 63 inches
annual mean relative humidity 71 to 75%
mean annual temperature 76–82° F
highest wind velocity (observed) 40 miles per hour

These figures are quoted for very general comparison only. Readers should consult the specific areal and altitudinal charts in Nuttonson (1963) for more exact data.

### *Soils*

Nuttonson (1963: 91) describes northern Thailand as a rough and steep mountainous land with shallow, strong soils occasionally interrupted by pockets of recent alluvial soils. R. L. Pendleton and S. Montrakun (1960: 15) have attempted to describe in more detail the soils of this area. Their *upland* soils are described as:

1. Intermediate elevation, shallow residual soils from quartzitic sandstones.
2. Higher forested hills on gneiss, generally sandy clay loam such as the *Kuntan* loams.
3. Limestone outcrops and crags.
4. Unclassified soils.

In the immediate vicinity of limestone outcrops are found pockets containing low heavy soils from weathered limestone and red friable clays more often called "tropical loams" (Pendleton and Montrakun 1960: 31). K. Punyasingh (n.d.) separates these "reddish to deep red" soils of limestone origin from the soil of lower elevations originating from sandstones or other igneous or metamorphic rock. The reddish forms, Punyasingh states, are rich in plant nutrients, the latter poor. Rice, being more adaptable to a wide range of soil fertility and physical conditions, is generally grown on these lower, poorer soils. The upland areas of rich, limestone-derived soils are today reserved for horticultural cropping.

On the slope beneath the Spirit Cave complex are numerous such pockets of limestone-derived soils. On the valley floor on either side of the Khong Stream are narrow (50–60 m) terraces composed of recent alluvium. During the short time available for excavation at Spirit Cave there was no opportunity to make natural history collections in the general vicinity.

### *Flora*

Very few data are available on the vegetation of northern Thailand. Fortunately, one of the most comprehensive vegetation maps has been compiled for an area of northern Thailand not far removed from the Spirit Cave locale (Küchler and Sawyer 1967). This study details the geographical distribution of plant communities in a specific area near Chiangmai. A second, more limited study of northern Thai phytocenoses was published in 1963 by T. Smitinand, and a general overview of the vegetation of Thailand, by area, is included in Nuttonson's monograph (Nuttonson 1963: 73–79).

It is possible to extrapolate, from the descriptive work of A. Küchler and J. Sawyer, and Tem Smitinand, a rough picture of the vegetation in the vicinity of Spirit Cave. The two areas, Chiangmai and Mae Hongson, are some 90–100 km apart; however, the parent sub-stratum underlying the research areas near Chiangmai also forms the Spirit Cave formation

(Ratburi limestone). Both of the studies noted above were described in terms of vertical strata which may be correlated with vertical increments in the Spirit Cave vicinity (Sawyer 1969, personal communication).

The vegetation can best be described in terms of two vertical zones: (1) the valley floor and (2) the higher slope vegetation.

### *The Valley Floor*

The valley floor is covered with dense vegetation very similar to Küchler and Sawyer's lower slope vegetation (1967: 306–307). The vegetation pattern consists of a tall canopy growth including: *Dipterocarpus obtusifolius*, *Lagerstroemia balansae* and *L. mucronata*, *Tectona grandis*, and *Terminalia arata*; a layer of lower, medium tall trees including *Cassia fistula*, *Dalbergia donganaiensis*, *Lagerstroemia macrocarpa*, and others; and a ground cover consisting mainly of graminoids and unidentified vines. Bamboo strands are ubiquitous and are most likely *Bambusa arundenacea* or *Bambusa truda*. This pattern occurs on both banks of the Khong stream and extends some 50 to 60 m up the slopes on either side of the valley.

### *Higher Slope Vegetation*

The higher slopes on either side of the valley are characterized by a continuation of the Dipterocarps; however, the trees are taller with larger crowns. The predominant canopy tree on these higher slopes is *Dipterocarpus costatus*. The next lower layer (the medium tall trees), including *Flemingia sootepensis*, *Mosinda anguistifolia*, and others, is much more open on the slopes than on the valley floor, and visibility through this area is quite good, hampered only by occasional low shrubs and vines. This vegetation pattern surrounds the Spirit Cave complex and extends up to the ridge top, some 100 m above the cave opening. Within 10 to 15 km of Spirit Cave are higher ridges where the vegetation pattern exhibits the third most visible change within the area. On the ridge summits above 800 or 900 m begin the pine-oak mixed forests of northern Thailand. The vegetation here is composed of medium tall broadleaf trees and needle leaf evergreen trees with a dense graminoid ground cover. The trees include *Pinus khasya*, *Pinus merkusii*, *Pinus insularis*, *Castanopasis argyrophylla*, and *Themeda triandra*, plus many other species (Küchler and Sawyer 1967: 320).

## *Fauna*

There have been no specific faunal surveys in northern Thailand, and no comprehensive checklists are available. D. Morris (1965: 26–28) cites the following as regional authorities for mammalian distribution: F. H. Chasen (1940) for south Malaya (under lat. 10° N) and parts of island Southeast Asia, J. R. Ellerman and T. Morrison-Scott (2d ed. 1966) for the Palaearctic, and E. M. O. Laurie and J. E. Hill (1954) for Celebes and New Guinea.

G. Tate's very general work, *Mammals of Eastern Asia*, includes sections on the "Subtropical Faunal Area" and the "Tropical or Malay Faunal Area" which, taken together, cover the northern Thai area and present the more commonly encountered species (Tate 1947: 20–29). Elsewhere I have enumerated the animal species (including nonmammals) existing in the area, and to this list have added the identified species from archaeological sites containing Hoabinhian material (Gorman n.d.). I feel a list such as this is necessary, since the Spirit Cave faunal assemblage becomes culturally significant only when examined in terms of the total exploitable fauna.

Since the faunal remains from Spirit Cave have not been fully identified, this comparison of exploited versus available species will appear in the final site report (Gorman n.d.). The following list is included here to give some idea of the fauna available.

There are numerous varieties of bats and rats, lemurs, Langur monkeys, macaques and gibbons, weasels and otters, Asian bears, most of the species of civets and mongooses, several cats, hares, squirrels, and long-tailed porcupines. Large mammals include various suids, various cervids, and muntjaks. The Khong stream contains several varieties of Cyprinid fish; numerous jungle birds are also present.

### *Inferences into the Past*

The foregoing information gives at least some idea of the present exploitable environment. The question remains: What was the exploitable environment available to an earlier (ca. 12,000 to 7000 B.P.) human population? Can we extend the known, present correlation of climate with flora and fauna into this period in the geologic past? This time period (ca. 12,000 to 7000 B.P.) brackets the Pleistocene-Recent boundary, and in other areas of the world this boundary has evidenced marked environmental change. This does not seem to be the case in the Southeast Asian humid tropics; it would appear that the late pleistocene environment of the area was quite similar to that of the present. In examining this argument the following must be considered: (1) the placement of the Pleistocene-Recent boundary in Southeast Asia and (2) the flora and faunal evidence.

#### *The Pleistocene-Recent Boundary*

Its relevance aside, where in time does one place this boundary in Southeast Asia? Examining this boundary in terms of its significance for Australian prehistory, R. Jones (1968: 192) has argued that the major temperature fluctuations during the Pleistocene-Recent transition were ". . . synchronous and of the same order of magnitude all over the world." Examining Pleistocene climates in the low latitudes, R. Flint (1963: 129) states that ". . . within this wide belt of latitude climatic changes have been generally contemporaneous during the last several tens of thousands of years."

Assuming low latitude climatic changes were synchronous, it is then possible to extrapolate from the data of Connolly (1967), Frerichs (1968), and M. Tsukada (1966) a general date for the Pleistocene-Recent boundary in Southeast Asia. Radiocarbon determinations from the above studies would place this boundary near either 10,000 B.P. (Connolly 1967: 873), 9000 B.P. (Frerichs 1968: 1486), or 11,000 B.P. (Tsukada 1966: 546), respectively. In the absence of other criteria a median figure of 10,000 B.P. (8000 B.C.) is accepted here as a reasonable chronological approximation for this boundary in Southeast Asia. The Spirit Cave radiocarbon sequence and associated deposits bracket this time placement (see Table 2).

#### *Flora and Fauna*

On the basis of the Jih-Yueh Tan pollen cores, Tsukada (1966: 545–546) has suggested that from 14,000 B.P. on, the Taiwan climate rapidly ameliorated to current tropical conditions. The Spirit Cave botanical remains indicate that the environment remained relatively constant from ca. 12,000 B.P. through to 7600 B.P. The presence of tropical species such as members of the genera *Lagenaria*, *Aleurites*, *Canarium*, *Trapa*, *Terminalia*, *Areca*, and *Raphia* indicates that the environment then (i.e., layers 4 through 2) was similar to that of today. These species are still found in the area. These botanical remains suggest an exploitative pattern tapping all zones from the valley floor to the ridge tops. Further, we can assume from these remains that tropical conditions must have existed, then as now, above this 400 m elevation.

Faunal remains from Southeast Asia have received more detailed study than have botanical remains. Extensive studies on Pleistocene-Recent fossil and subfossil mammalian faunas from various sites in Southeast Asia have led D. A. Hooijer (1962: 485–489) to conclude that an almost entirely modern fauna was already present during the late Pleistocene on Java. From the Niah Cave site in Borneo, Hooijer has studied a faunal assemblage dating from 32,000 B.P. This assemblage was composed primarily of modern, extant species today associated with the tropical Southeast Asian rain forest ecosystem (Hooijer 1961: 166). Faunal remains from Spirit Cave indicate that the fauna of this area was also composed of modern species well back into the late Pleistocene.

From the climatological, botanical, and faunal evidence now available there would appear to have been little change in the Southeast Asian environment from the late Pleistocene through to the present.

This present environment, then, can be projected back into the past, suggesting an environmental potential against which selective factors in the cultural ecology of the early inhabitants of Spirit Cave may be evaluated.

## Archaeological Research at Spirit Cave

### *Introduction*

Spirit Cave was known to local hunters in the Thai-yai village of Mai Sang Nam. It was they who directed me to the site and were later hired as excavators. Spirit Cave is actually a complex of three separate areas (Fig. 2) weathered into the limestone butte by percolating rain water. A lower cave which measured about 15 m by 18 m across the greatest distance and about 8 m in height contained no cultural deposit; the limestone floor was very rough and was covered with large boulders. A small opening along the southeast wall gave access to a middle cave that I originally designated as Site 19. This middle cave I now refer to as Spirit Cave and it was the main area of excavation. Spirit Cave is some 10.5 m by 7 m with a ceiling which slopes from about 4 m at the opening to approximately 1 m at the rear of the shelter. At the front of the shelter large limestone boulders form a natural, irregular wall roughly 1 m high across the opening (Fig. 3, *inset*). At the rear of the shelter there is a natural rise of the underlying limestone and two openings—one into a rear cave some 5 m long by 3 m wide and about 2.5 m high; the other drops down some 3 m into the lower cave. Toward the rear of the small back cave there is another opening into the lower cave (Fig. 2). At the same level as the entrance to Spirit Cave, a narrow ledge projecting about 20 cm from the cliff face runs southeast from Spirit Cave for about 9 m to the opening of the upper cave. The upper cave (not shown) extends back into the cliff face some 8 m. It is about 2.5 m wide, and varies from 2 to 3 m in height. Within the Spirit Cave complex, then, there is a lower cave, a middle shelter-cave (Spirit Cave), and an upper cave. Spirit Cave itself contained the only cultural deposit of any depth; the back cave and the upper cave did have stratified deposits, but these were only 8 to 12 cm in depth and from the contents represented mainly Layer 2 and Layer 1 material of the Spirit Cave sequence.

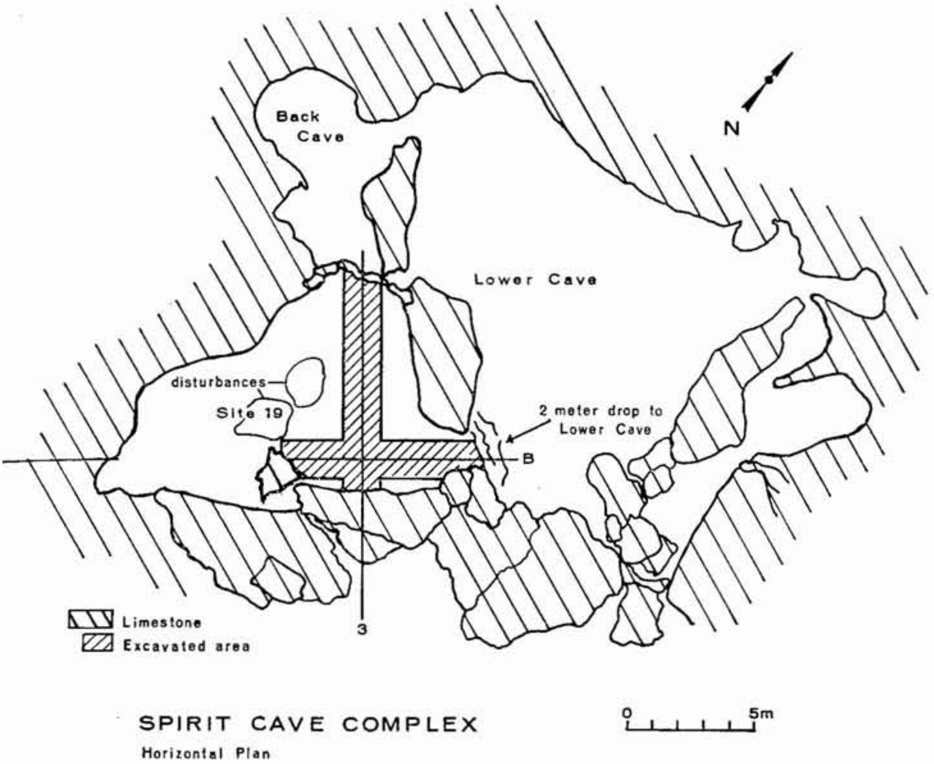


Fig. 2 Spirit Cave complex.

*Research Methodology*

I first located this complex during a survey of the northern section of Mae Hongson Province. As the terrain is extremely rugged and must be surveyed on foot, I travelled with a light pack and one assistant. I would stay several nights in each village inquiring about the presence of caves, shelters, sherds, or other such conditions known to the villagers. During the days I would examine the areas suggested, and when I had checked all possible sources, I would move on to the next village.

I first heard about the Spirit Cave complex during the middle of April 1966. I hired guides from Mai Sang Nam and examined the complex first on 25 April 1966. The surface of the Spirit Cave deposit was very promising; large quartzite cores, flakes, and cord-marked sherds were immediately observable. Two large disturbances covering several square meters extended some 50 cm down into the deposit. A 1.5 m grid was constructed over the entire shelter floor. This was constructed so that the midline of one baulk (coordinate 3) would lie perpendicular to the shelter opening and would lie over as deep a section of the undisturbed deposit as possible (Fig. 4). The grid lines, perpendicular to these and parallel with the cliff face, were adjusted so that one of these would also lie over as long an undisturbed section as possible. Grid lines perpendicular to the cliff face were numbered; those parallel to the cliff face were given letter designations (Fig. 4). One-meter squares were used as units of horizontal excavation; these were identified by the letter-number coordinate intersection at the southwest corner. I excavated square B3 as a test square and

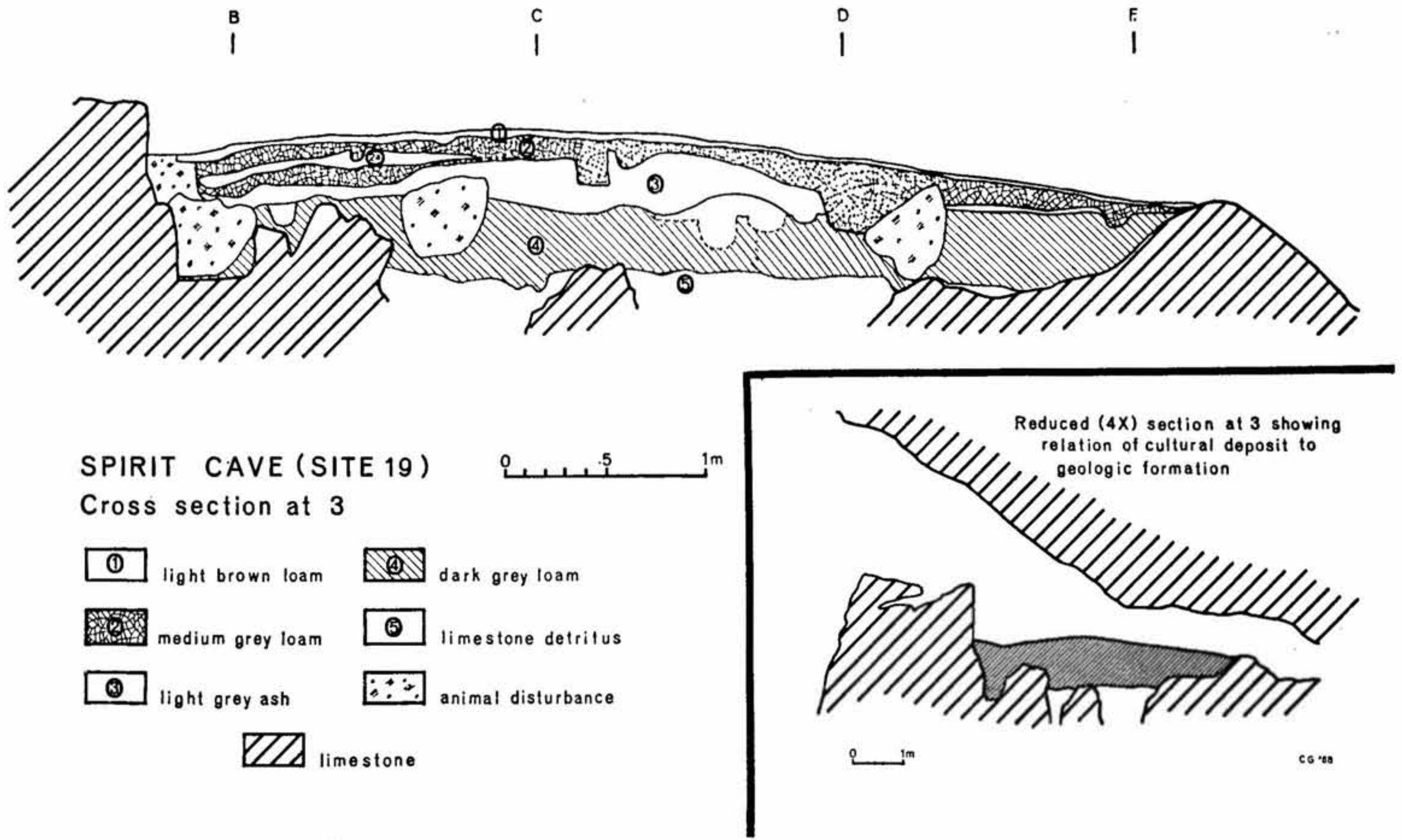


Fig. 3 Spirit Cave: general stratigraphy sequence. Inset: limestone boulders forming natural wall, front of shelter.

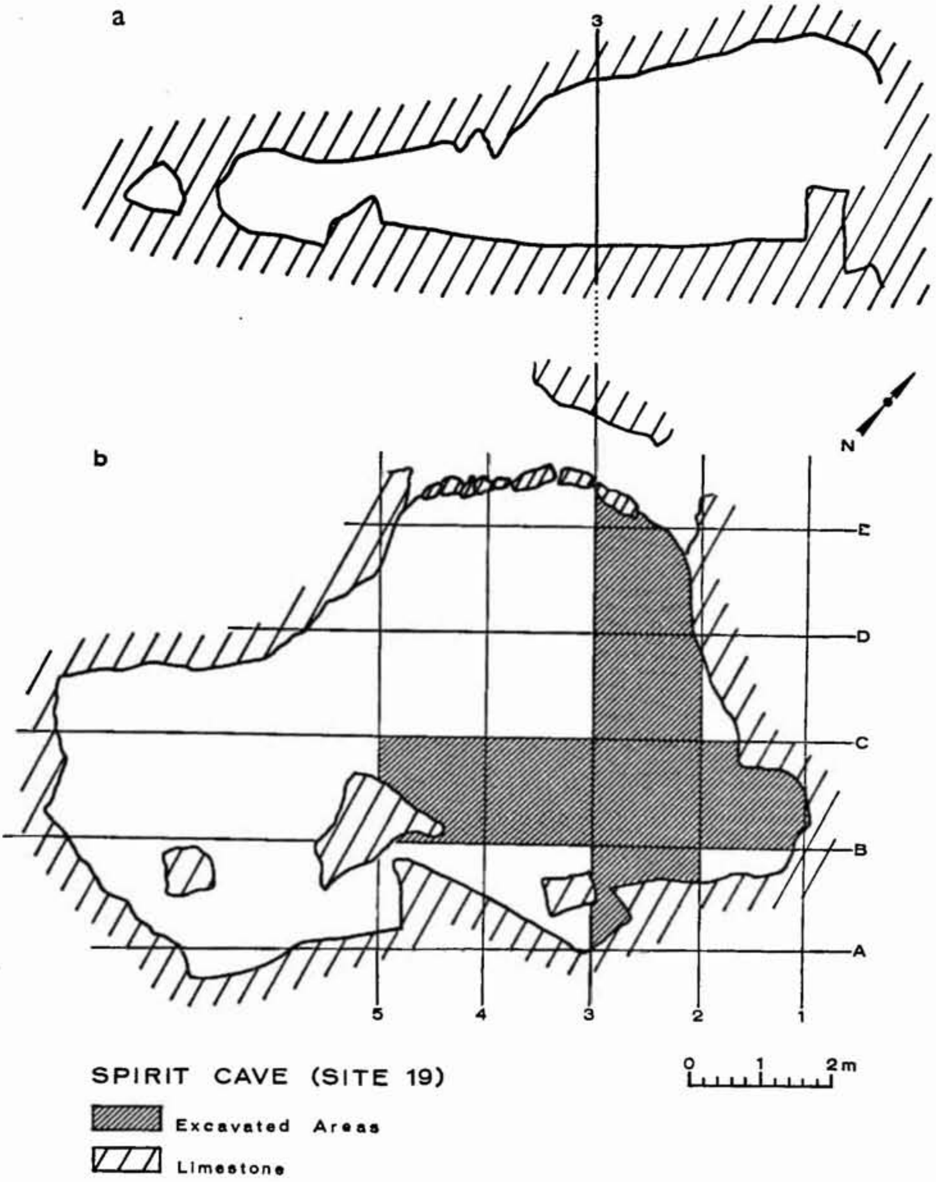


Fig. 4 Spirit Cave grid lines.

the results were promising, as I expected. I returned to Chiangmai for equipment and supplies and returned immediately to Spirit Cave to excavate as much as possible before the area was closed off by the heavy monsoon rains.

One-meter squares were excavated using the natural strata as units of vertical control. Fifty-centimeter baulks were left in place until all squares were excavated; these were then excavated to provide intersecting profiles across the deposit (Pl. I). Owing to internally complex stratigraphy and localized ash lenses, several squares were excavated in 8 to 12 layer units. Thick, homogeneous layers (especially segments of Layer 3 and Layer 4) were excavated in spits of 10 or 15 cm as an aid to vertical control. The surface of each new stratum was measured from eight points within each square and at each corner and midway along each wall. Following the excavation of each square, sections were drawn of each wall face, and these faces were photographed in black and white and in color. After the number 2 baulks had been lifted, a complete section was drawn along coordinate 3. The measurements, section drawings, and photographs were then correlated across the site resulting in the general stratigraphic sequence shown in Figure 3. All excavation was done by trowel and brush; all excavated material, with the exception of specific soil samples, charcoal samples, etc., was screened through a 1-mm mesh screen. Two such screens were erected and manned by two crews of two men each. With the exception of naturally fragmented limestone all material that did not pass through this 1 mm mesh was bagged according to its horizontal and vertical provenience. Owing to the use of these techniques, the excavation proceeded very slowly. The aim of this method was not to excavate as much as possible, but rather to retrieve as much of the data as possible.

## *The Stratigraphic Sequence*

### *Soil Horizons and Excavation Layers*

With the exception of Layer 5, the soil formation in Spirit Cave is composed almost entirely of cultural debris. The differing soil characteristics reflect temporal differences in the occupational use of the site. Because of these differences, the soil layers, or segments thereof, were used as excavation layers, and these layers conform to cultural differences expressed not only in soil composition, but also in artifact content. Because of its thickness and internal lensing, Layer 3 was removed in several segments (identified by the red lensing), or in spits (reflecting a tightening of vertical control through the homogeneous deposit). Layer 4 was in most areas a thick (40 cm plus) completely homogeneous deposit and was generally excavated in at least two artificially separated spits. In two squares, B2 and D2, Layer 5 was excavated to the limestone bedrock of the shelter's floor. From top to bottom the five general soil and excavation layers are (Fig. 3):

Soil Layer 1: a brown (dry 10 YR 3/3) loamy sand, pH 7.2, containing cultural material, and extending *in situ* across the surface of the excavated area. This layer varied in thickness from 3 cm to 8 cm and flaked away easily from the surface of Layer 2.

Soil Layer 2: a gray (dry 7.5 YR 5/2 to moist, 10 YR 2/1), very fine sandy loam, pH 7.5, containing cultural material, numerous ash and charcoal lenses, and a heavy concentration of charcoal toward the opening of the shelter. Layer 2 varies in thickness from 20 cm to 5 cm and extends over the entire excavated area. Several pits had been dug from Layer 2 into Layer 3, and on one occasion in baulk C2-D2, through Layer 3 to the surface of Layer 4. The top of Layer 2 was quite compact and under Layer 2, the Layer 3 soil was easily identified by a marked color change. Where pits extended from Layer 2 into Layer 3 the soil color became a blend of the two separate soils.

Soil Layer 2*a*: A dark gray (dry, 10 YR 4/1) lens containing some cultural material and heavy concentrations of bamboo charcoal.

Soil Layer 3: A gray (dry, 5 YR 6/1), fine sandy loam, pH 7.5, with dark reddish brown (dry, 5 YR 3/4) layers lensing in and out within the generally ashy gray matrix. Several pits had been dug from Layer 3 into Layer 4, and the Layer 3-Layer 4 interface is quite disturbed in square C2 (Fig. 3 and Pl. I). The gray ash of Layer 3 flaked away from the dark matrix of Layer 4.

Soil Layer 4: A dark grayish brown (dry 7.5 YR 5/2 to 10 YR 3/2), very fine sandy loam, pH 7.4, containing cultural material, and extending in a very thick, *in situ* layer across the entire excavated area. The dark grayish brown of Layer 4 troweled away easily from the surface of Layer 5.

Soil Layer 5: A sterile, dark yellowish brown (dry, 10 YR 3/4) limestone detritus with numerous small hearths dug into its surface. Thirty to 50 cm down, this layer terminates in the limestone bedrock of the shelter's floor.

*Soil Layers as Cultural Depositions*

In its original state Spirit Cave was a small, very dry, rock shelter with a shallow layer of natural limestone detritus. The first occupants of the shelter scooped out small (20 to 30 cm) depressions and made small fires, laying the firewood in a radial fashion. Cultural and faunal remains are described below. Several such hearths were excavated.

Upon this natural and otherwise sterile layer, Layer 4 was deposited. Layer 4, from its homogeneous nature, would appear to be the result of a fairly continuous occupation over a considerable period of time. There was a uniform buildup of this layer over the entire excavation area.

The change in soil characteristics of Layer 3 suggests possible intermittent use of the shelter. Hearths were constructed over the entire surface of the excavated area and the main buildup of this layer occurred in the center of the shelter. The dark reddish brown lenses appear to have resulted from soil oxidation under the numerous fires occurring over the surface during the formation of this layer. Numerous pits were dug from this layer down into Layer 4.

Layer 2 is again a homogeneous layer and, like Layer 4, it appears to have been the result of a relatively continuous use of the shelter. Fires were constructed in localized areas, and aside from pits dug into Layer 3 and occasionally through Layer 3 into the surface of Layer 4, the layer is evenly distributed over the entire excavated area. Layer 2*a* represents a single event, the building of a large fire within Layer 2. The surface of Layer 2 was compacted, and numerous potsherds were scattered about and pressed into the surface as if they had been walked on long enough to level them into the surface compaction. The ceramic material does not appear until the surface of Layer 2. A small hearth on the surface of Layer 2 had in direct association one quadrangular adze, and nearby, the fragments of another. The surface of Layer 2 can be viewed as a living surface during the use of which new cultural elements came into the Spirit Cave area.

Layer 1 is a very thin, relatively homogeneous layer, which again would appear to represent a relatively continuous, short-term use of the shelter. Layer 1 represents the last culturally deposited soil horizon. Some time after the deposition of Layer 1, large "boat-shaped" coffins were erected on scaffolds in the lower, middle, and upper cave; these will be discussed in the final site report (Gorman n.d.).

*Cultural Levels*

Examining the general layers (Fig. 3), I will group Layer 4, 3, 2*a*, and 2 into a general Cultural Level I that I will define as one subcultural assemblage of the more widely spread Hoabinhian technocomplex. Whether this assemblage evidences the time trajectory of a regional or occupational subculture is not yet determinable. Artifacts from Cultural Level I reflect Hoabinhian key traits as listed above.

From the surface of Layer 2 on through Layer 1 are found artifacts that indicate a culture contact situation; most probably these artifacts represent a secondary diffusion of the specific types into the Spirit Cave area. Artifacts of Cultural Level I continued to be used on in time through to the surface of Layer 1. The new artifact types constitute an addition to, rather than a replacement of, Level I materials.

*Cultural Remains*

*Introduction*

Cultural remains will be discussed by cultural levels in terms of lithic materials, faunal and floral remains, ceramics, and inferential data. A recent attribute-oriented statistical analysis of a Hoabinhian assemblage by Matthews (1964) has shown the difficulty in establishing formal types within this rather amorphous flake-core assemblage. White (1969: 18–19) has already discussed the difficulties involved in establishing typologies for a similar, morphologically undifferentiated stone industry from the New Guinea Highlands. Within the Spirit Cave assemblage there are few representatives of formal types associated with the Hoabinhian materials. These consist primarily of the sumatraliths and the grinding stones with associated ochre (Pl. II). The quadrangular adzes and the slate knives of Cultural Level II also conform to formalized types; however, the vast majority of stone artifacts from both cultural levels are identifiable only by their edge-damage patterns (Pl. III). Following the orientation of a number of archaeologists (especially Semenov 1964; Sonnenfeld 1962; Keller 1966; Witthoff 1967; Wilmsen 1968; Frison 1968; Sanger 1968; MacDonald and Sanger 1968; White 1969; and others) I am presently engaged in a statistical analysis of macroscopic and microscopic attributes of the Spirit Cave assemblage (Gorman n.d.). The repetitive, statistical association of macroscopic and microscopic attributes should yield a typology of functional categories. Although the analysis is not yet complete, certain edge-damage patterns are common and worth noting.

Lack of modern comparative material makes the faunal identifications tentative. The botanical identifications are more specific; the remains are now under more detailed analysis (thin sectioning, etc.) by Douglas Yen, ethnobotanist, at the Bishop Museum, Honolulu. Pollen studies from the Spirit Cave sequence are also under way. The ceramic material has undergone detailed analysis, and I am now in the process of preparing and analyzing representative thin sections. Final results of this research will appear in the final site report (Gorman n.d.). Analysis completed at this time allows us to describe the following:

*Cultural Level I* (Hoabinhian)

*Lithic.* Coarse-grained quartzite was the stone most commonly used through all layers at Spirit Cave. It is readily available along the Khong Stream, and this seems to have been the major source of the stone. We can immediately speak of three categories of stone artifacts: large unifacially worked pebble cores, grinding stones, and retouched and utilized flakes.

The large unifacially worked pebble tools include some that have previously been termed sumatraliths (Pl. II*a*). The most common edge damage on these is severe step-flaking (Pl. III*b*).

The grinding stones occur as well-defined formal types (Pl. II*e–f*) and as small grinding surfaces on otherwise nondescript river pebbles. Ochre (iron oxide) has been found in association, and all grinding surfaces bear traces of this pigment.

The retouched and utilized flake category is by far the largest and most interesting group of artifacts. Microscopic analysis has enabled us to recognize damage patterns (striations, abrasions, etc.) both parallel and perpendicular to flake edges, and step fractures generally occurring on larger quartzite and basalt flakes (Pl. III*a–c*). Apparently unique in the Spirit Cave assemblage are small calcite blades with a damage pattern perpendicular to the blades' longitudinal axes. With great skill these blades have been pressure flaked from large calcite fragments. A characteristic damage pattern of abraded, semicircular or concave deformations is associated primarily with chert flakes (Pl. III*d*). These concave damage patterns vary from about 5 mm to 7.5 mm in diameter. Some flakes evidence slight retouching, and occasional flakes have been retouched all along one edge. Edge-damage patterns occur on some 30 percent of the flakes collected, and most of them require microscopic detection.

*Fauna*. With the exception of bat bones, the faunal remains from all layers were recovered in an extremely fragmentary, generally uncharred condition (Higham n.d.). From Cultural Level I come remains of bovids, bats, cervids (including *Cervus unicolor*), rats, reptiles, suids, snakes, birds, squirrels, primates, freshwater fish, shellfish and turtle. In the absence of good comparative materials it is at present difficult to examine the faunal remains for evidence of domesticated species. A particularly small proximal end of a suid tibia (proximal width estimated at under 35.0 mm) may, according to Higham (n.d.: 2), indicate an early variety of domesticated pig. More detailed analysis of these remains is now in progress.

*Flora*. Identifications of botanical macrofossils, some charred and others naturally preserved in the very dry Spirit Cave deposits, are presented in Table 3 (Table 3 was made by Douglas Yen and associates, Bishop Museum, Honolulu). Three uprights of *Bambusa* spp., 9 cm in diameter, had been erected at the front of the shelter during the occupation of Layer 2. Three holes, with fragments of the bamboo upright still in place, extend into Layer 3.

*Other*. Also present were concentrations of iron oxide (ochre) and fragments of sun- or fire-baked clay, which appears to have been molded around sections of bamboo 3 to 4 cm in diameter.

*Cultural Level II*

*Lithic*. The Hoabinhian assemblage described for Cultural Level I continued in use through Layer 1, and artifacts of this type were found on the surface. New artifact types, however, came into the continuing Hoabinhian expression while the surface of Layer 2 was in use as a living floor. New artifact types include flaked and polished quadrangular adzes, small ground and polished slate knives, and cord-marked and burnished ceramics.

One complete adze, one broken adze fragment, and one adze blank were recovered from Level II (Pl. IV). The complete adze and the broken fragment were both associated with a hearth yielding a charcoal sample (GaK 1846). The above three artifacts appear to be made of limonite (detailed petrographic analysis is now underway), and this appears to be the only limonite recovered during the excavation. Two small slate knives, identical in form and material, were recovered from the surface of Layer 2, and two fragments of another from screenings of Layer 1 soil. From the associated radiocarbon determinations, the above artifacts (adzes and knives) appear to be the earliest dated examples of edge grinding in Mainland Southeast Asia. The dates also suggest a very surprising antiquity for the simple quadrangular adze.

*Ceramics*. Ceramic material from Spirit Cave is limited to the surface of Layer 2 and to Layer 1. No complete vessels were recovered, nor was it possible to reconstruct vessels from the very fragmentary sherd collection. Judging from the rim sherds and a detailed microscopic analysis of the individual sherds, the entire collection may represent less than 20 complete vessels. The sherds will be discussed in detail later (Gorman n.d.); for now, they will be separated into two types: cord-marked and burnished ware.

1. *Cord marked (Pl. V). (Sample: 331 sherds, 680 grams, including miscellaneous sherds.)*

*Surface finish (outside):* The cord-marked sherds from Spirit Cave have been separated into 9 different sherd samples; a detailed description will appear in the final report. The 9 sherd samples are relatively homogeneous, and in a preliminary description can be grouped together. Most characteristic is their cord-marked surface finish, which is described below following D. and C. Osborne (1954), A. Shepard (1965), I. Emery (1966), and W. Hurley (1968).

Both $Z\,{}^{s}_{s}$ and $S\,{}^{z}_{z}$ constructed cords were impressed into sherd surfaces. These cords were formed with a loose (helix angle 10°) to medium loose (helix angle 15° to 20°) twist and average from 1 to 2 mm in diameter. The cord was wrapped about a paddle, or other flat surface, and impressed into the surface of the wet clay. Striations visible in plasticene impressions of the individual plys suggest the cordage was made from some very coarse plant material. In her section on miscellaneous plant material, Emery (1966: 4–5) lists raffia as one of the more common materials used in cord manufacture. Raffia is present in the Spirit Cave deposit and may have been among the materials used for cord manufacture. In general, the cordage was manufactured with a loose twist (helix angle 10°). However, one sherd sample shows impressions of a fine 0.5 mm cord, or twine, with a helix angle of approximately 30°; therefore, it must be placed in a tightly twisted twine category (Emery 1966: 12). This is such a fine, tightly twisted cord that the resulting clay impressions at first appeared to be made up of almost parallel, straight grooves with no indication of cord-twist patterns (Pl. V*a*).

One sherd sample bears the impression of an interlocking twist, fixed-dimension net. A $Z\,{}^{s}_{s}$ cord with a loose twist helix angle (10°) has been formed into netting by interlocking one, sometimes both, of the plys of one cord into the twist of the other (Pl. V*b*); the twist of the latter then holds the former in place. Although there is no knotting of the cords, the result is still a net of relatively fixed dimension. On these net-impressed sherds is also found a raised, triangular (in cross-section) appliqué band 5 mm wide and 5 mm high (Pl. V*c*). This appliqué band was joined to the pot after the surface had been net-impressed. This is the only appliqué found in Spirit Cave. These net-impressed sherds exhibit one other unique attribute: they have, after firing, been coated with an organic resinous material (Pl. V*d*).

*Surface finish (inside):* The inside of most of these sherds has been burnished to a smooth, lustrous finish. Lustrous streaks of 3 mm to 5 mm indicate that a small pebble, seed, or other smooth instrument was used as a burnishing tool (Pl. V*e*). The inside walls were burnished while in a leather hard state. Coarse temper grains have been levelled, and there was no shrinkage of the clay body away from these levelled grains. The sherds with resin-

Plate I Spirit Cave during excavation.

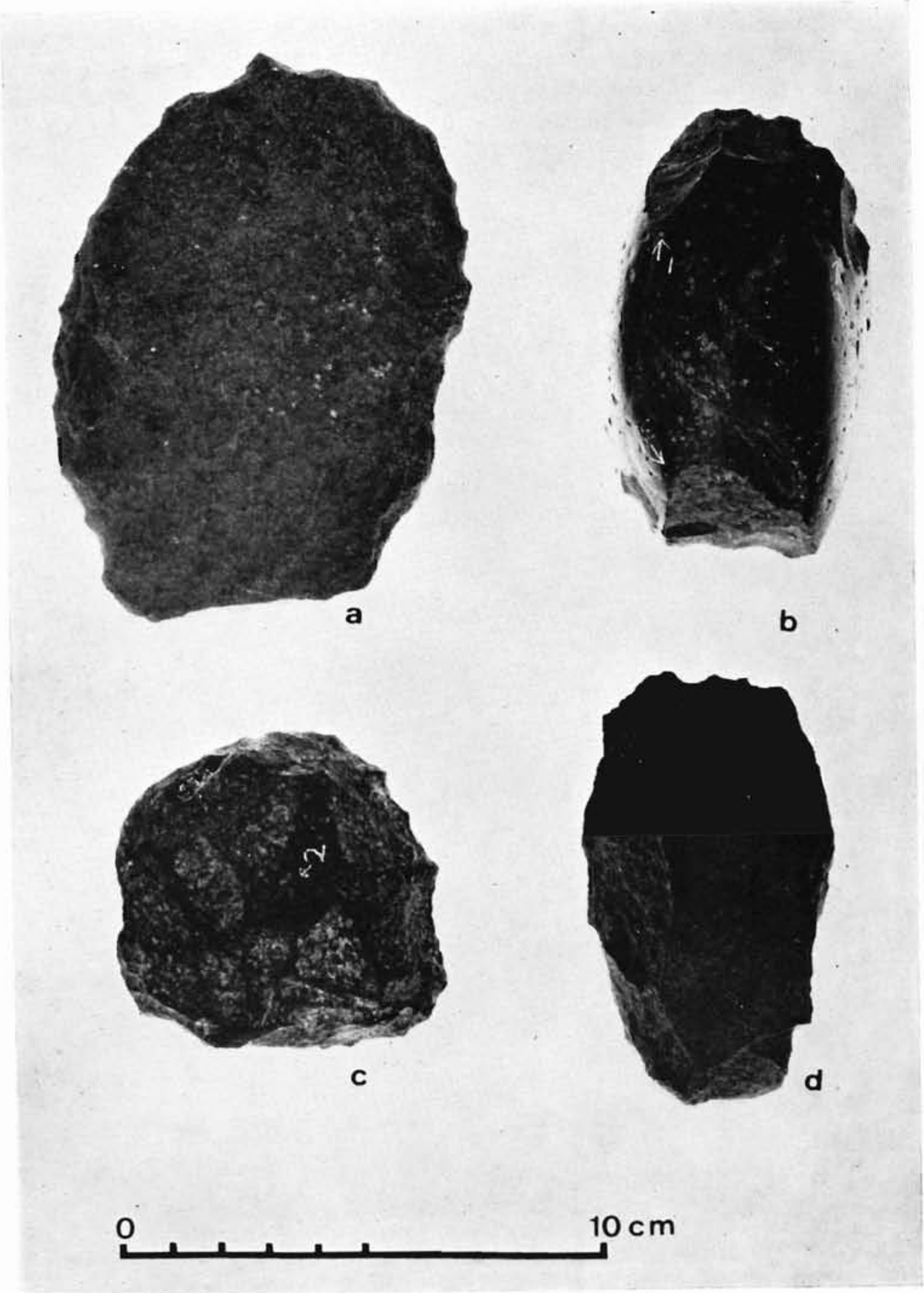


Plate II*a–d* Unifacially worked pebbles.

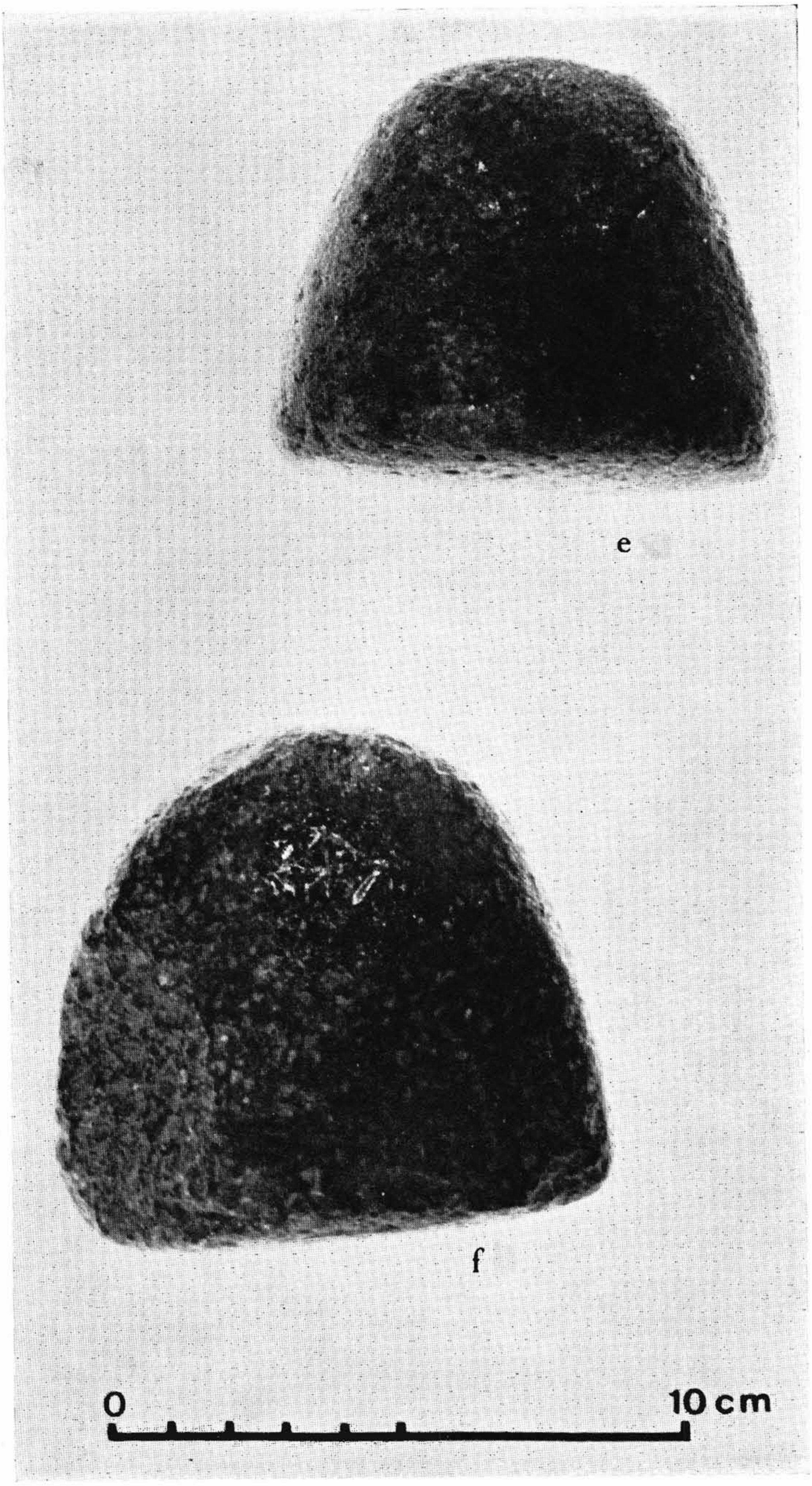


Plate II*e–f* Grinding stones.

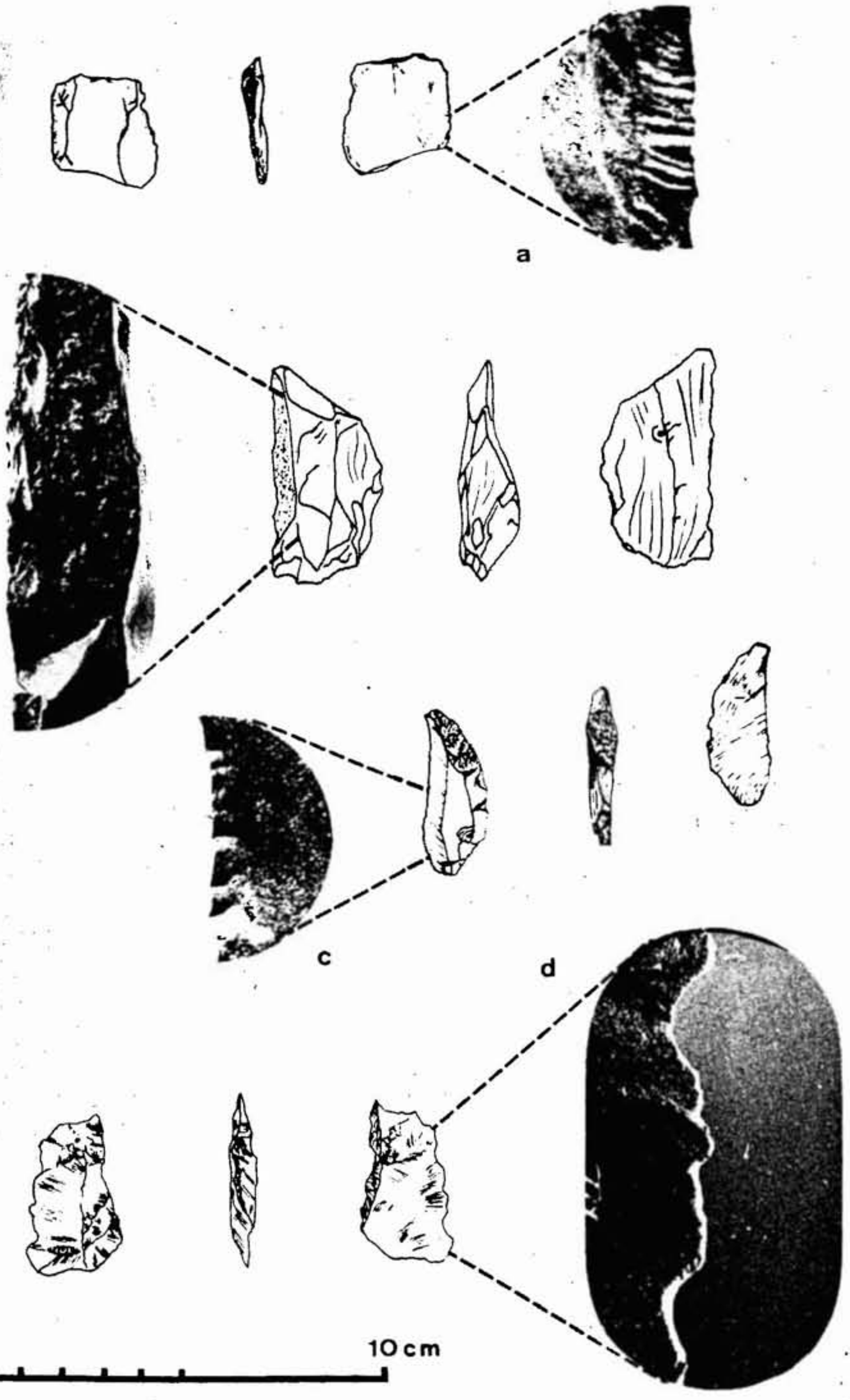


Plate III Edge damage of flake artifacts from Spirit Cave.

Plate IV Adze, adze fragment, and adze blank recovered from Spirit Cave.

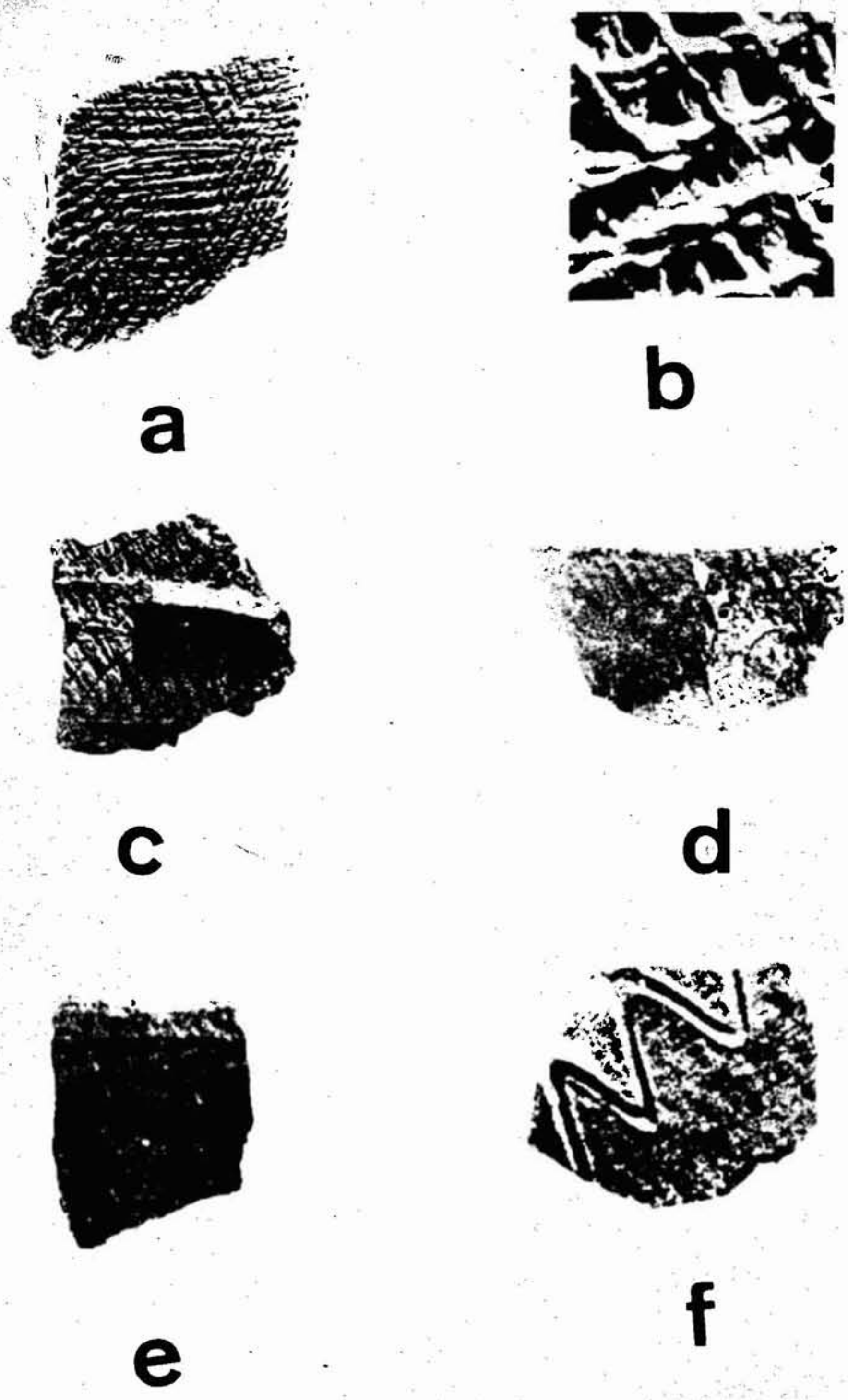


Plate V Cord-marked and burnished sherds from Spirit Cave. *a*, fine cord-marked pattern; *b*, enlarged section of an impression in plasticene of a net-marked sherd; *c*, appliqué band; *d*, net-impressed sherd with organic resinous coating; *e*, streaks indicate use of small burnishing tool; *f*, incised, burnished sherds.

coated exterior walls (above) were not burnished inside, but are coated inside with heavier coats of the same resinous material.

*Paste:* There is a slight variation in the paste of these cord-marked sherds, perhaps representing the paste composition of individual vessels. Exterior wall colors vary, but approximate a range from dark reddish gray (5 YR 4/2) to dark brown (7.5 YR 3/2). There appears to have been considerable range on single vessels, and dark smudging is common. Interior wall color ranges from very dark gray (7.5 YR N3/ ) to black (7.5 YR N2/ ). Within the walls' cross sections, the transition from one range to another is gradual.

Temper inclusions consist primarily of angular, calcite fragments varying in size from medium to coarse on the Wentworth scale. The angular nature of these rhombic calcite fragments seems to indicate mechanical crushing rather than natural weathering or crystalline growth. Also, the moist conditions surrounding clay formation in the area would almost preclude their natural inclusion, as in such a moist situation, the calcite would most probably dissolve. Coarse water-worn sand is also present in the clay body; this may represent artificial tempering or a naturally occurring, nonplastic inclusion.

*Forms and manufacturing techniques:* Depressions on the interior wall surfaces indicate that the vessels were manufactured by impact modelling (Shepard 1965: 392). The exterior of the vessel was finished with a paddle or other flat object, around which cordage had been wrapped as described above. The interior of the vessel was generally burnished. Rims are generally of Shepard's (1965: 246) simple direct construction, though modified rim forms are also present.

The color variation in exterior and interior walls suggests that the exterior wall underwent oxidation firing while the interior wall experienced reduction firing. Refiring of these sherds in a controlled, oxidation firing supports this hypothesis. If the vessels were fired upside down in an open fire these conditions would be met. Improper circulation would result in smudging on the exterior wall surface, and trapped vapors inside the down-turned vessel would result in a closed reducing atmosphere.

From the fragmentary remains available, it is difficult to say much about the form of the complete vessels. A few rim and larger body sherds do give some idea of size and form. Rim arc indicates rim openings from 10 to 18 cm in diameter. Larger body sherds' areas suggest globular bodies 16 to 26 cm in diameter. In combination with rim sherds these body sherds suggest an independent restricted vessel with inflected contours (after Shepard 1965: 23, Fig. 22, I.P.V.T.). Wall thickness varies from 5 to 9 mm.

2. *Burnished (95 sherds, 140 grams).*

*Surface finish (outside and inside):* These sherds have been burnished on both the exterior and interior wall surfaces. A tool was used that left lustrous striations ranging between 1.5 mm and 2 mm in width. These striations run horizontally around the vessel, parallel to the rim. Some incising was done on burnished sherds; however, only a few examples were recovered (Pl. V*f*). Coarse quartz temper inclusions have been levelled in the burnishing process; subsequent to this there was no shrinkage of the clay body. In general, incising was done in a wavy line pattern.

*Paste:* There is considerable variation in the paste of these sherds. The paste includes coarse to very coarse water-worn, nonplastic inclusions; very angular, coarse quartz fragments are also present. Sherd walls average about 5 mm in thickness. There is some variation in color, perhaps reflecting the color of individual vessels. The exterior walls range from a grayish brown (10 YR 3/2) to a yellowish brown (10 YR 5/4). Interior walls are generally black (7.5 YR N2/ ), though some are dark gray (10 YR 4/1).

*Form and manufacturing techniques:* Depressions in the interior wall surfaces indicate impact modelling. The condition of the burnished surfaces suggests that the clay was leather hard when burnished. From the small number of sherds available, the form and manufacturing techniques seem very similar to those described for the cord-marked sherds.

*Fauna.* As in Cultural Level I, the faunal remains from this level are generally uncharred and extremely fragmentary. Identified from this level were remains of bats, cervids, rats, reptiles, suids, birds, squirrels, and primates. Freshwater fish, shellfish, and turtle were also present (Higham n.d.: Table II).

*Flora.* Identified from Cultural Level II were remains of *Palmae areca*, *Piperaceae piper*, and *Burseraceae canarium.*

*Other.* Concentrations of iron oxide and the sun- or fire-baked clay fragments mentioned from Cultural Level I continued through Cultural Level II. From impressions on the cord-marked sherds it is apparent that simple cordage, twine, and very fine mesh net were available and undoubtedly used in other cultural activities.

### *Radiocarbon Chronology*

Fourteen charcoal samples have been submitted to various laboratories for Carbon-14 analysis; nine have been completed. These are shown to two standard deviations (Table 2). A correlation of layers, levels, and radiocarbon determinations is shown in Table 1.

The majority of carbon samples were collected during the last week of excavation, and a number of steps were excavated into the baulks for the express purpose of obtaining strategically located Carbon-14 samples. By this time we had a good understanding of the

TABLE 1

RADIOCARBON RESULTS FROM SPIRIT CAVE: A SCHEMATIC CORRELATION OF CORRECTED DETERMINATIONS WITH GENERAL LAYER AND LEVEL DESIGNATIONS

| GENERAL LAYERS | CULTURAL LEVELS | RADIOCARBON DATE B.P. |
|---|---|---|
| 1 | | 7622±300 (FSU 317) |
| | II | |
| 2 | | 8142±390 (FSU 314) |
| | | 8806±200 (GaK 1846) |
| 2*a* | | 8750±140 (TF 802) |
| | | 8776±290 (FSU 318) |
| 3 | | |
| | I | |
| 4 | | 9455±360 (GaK 1845) |
| | | 10,390±310 (TF 803) |
| | | 11,237±580 (FSU 316) |
| | | 11,690±560 (FSU 315) |
| 5 | | |

NOTE: Four samples are still under analysis at the British Museum, London.

TABLE 2
RADIOCARBON RESULTS FROM SPIRIT CAVE, NORTHWEST THAILAND, IN YEARS B.P.

| LAB NO.* | SQUARE | EXCAVATION LAYER | GENERAL LAYER | UNCORRECTED DATE† | CORRECTED DATE‡ | RANGE 1SD | RANGE 2SD |
|---|---|---|---|---|---|---|---|
| FSU 317 | B2-B3 | 2 | 1 | 7400 ± 300 | 7622 ± 300 | 7922–7322 | 8222–7022 |
| FSU 314 | A2-B2 | 2 | 2 | 7905 ± 390 | 8142 ± 390 | 8532–7752 | 8922–7362 |
| GaK 1846 | A2-B2 | 2 | 2 | 8550 ± 200 | 8806 ± 200 | 9006–8606 | 9206–8406 |
| TF 802 | B2-B3 | 2a | 2a | — | 8750 ± 140 | 8890–8610 | 9030–8470 |
| FSU 318 | B3-B4 | 2a | 2a | 8520 ± 290 | 8776 ± 290 | 9066–8486 | 9356–8196 |
| GaK 1845 | B2-C2 | 5 (surface) | 4 | 9180 ± 360 | 9455 ± 360 | 9815–9095 | 10,175–8735 |
| TF 803 | B3 | 3 | 4 | — | 10,390 ± 310 | 10,700–10,080 | 11,010–9770 |
| FSU 316 | B2 | 5 | 4 | 10,910 ± 580 | 11,237 ± 580 | 11,817–10,657 | 12,397–10,077 |
| FSU 315 | C2 | 3 (mixing) | 3/4 | 11,350 ± 560 | 11,690 ± 560 | 12,250–11,130 | 12,810–10,570 |

* FSU=Florida State University; GaK=Gakushuin University; TF=Tata Institute of Fundamental Research.
† Radiocarbon determinations based on Libby half-life of 5570 years.
‡ Radiocarbon determinations corrected to half-life of 5730.

TABLE 3

SPIRIT CAVE, THAILAND, PLANT REMAINS (ARRANGED IN LEVELS)

| IDENTIFICATION Family | Genus | PLANT PARTS | CONDITION | QUANTITY | EXCAVATION LEVELS |
|---|---|---|---|---|---|
| CUCURBITACEAE | *Lagenaria* | Fruit exocarp | Fragments | Many | B1-B2 3 |
| PALMAE | *Areca* | Seed-case | Fragments | 2 | B1-B2 4 |
| PALMAE *or* LEGUMINOSAE | *Raphia** *Pisum* | Seed | Entire, carbonized | 1 | B1-B2 4 |
| LEGUMINOSAE | *Phaseolus*† or *Glycine* | Seed | Entire, carbonized | 1 | B1-B2 4 |
| BURSERACEAE | *Canarium* | Seed-case | Fragments, carbonized and natural | Many | B3 1 |
| CUCURBITACEAE | *Cucumis* | Seed | Entire | 1 | B3 1 |
| PALMAE | *Areca* | Seed-case | Fragments | Many | B3 2 |
| PIPERACEAE | *Piper* | Seed-case (half) | Fragments | 1 | B3 2 |
| LEGUMINOSAE | *Phaeolus*‡ *Vicia* | Seed | Entire, carbonized | 1 | B3 2 |
| BURSERACEAE | *Canarium* | Seed-case | Fragments | 3 | B3 2 |
| EUPHORBIACEAE | *Aleurites* | Seed-case | Fragments, carbonized | Many | B3 2 |
| SAPOTACEAE | *Madhuca* | Seed-case | Fragment | 1 | B3 2 |
| ROSACEAE | *Prunus* | Seed-case | Fragments | 3 | B3 3 |
| TRAPACEAE | *Trapa* | Seed-case | Fragment | 1 | B3 3 |
| CUCURBITACEAE | *Lagenaria* | Fruit exocarp | Fragments, carbonized | Many | B3 3 |
| PALMAE | *Areca* | Fruit petioles | Fragments, carbonized | 3 | B3-B4 2*a* |
| COMBRETACEAE | *Terminalia* | Seed-case | Fragment | 1 | B3-B4 3*a* |
| CUCURBITACEAE | *Lagenaria* | Fruit exocarp | Fragments | Many | B3-B4 3*a* |

* The point of attachment of the round seed is prominent and situated on the one flat portion of the surface, making the Palmae identification more likely.

† Previously recorded as *Phaseolus*, but there is nothing to differentiate the seed from *Glycine* or other large seeded legumes.

‡ The possible identification of this seed as *Vicia* is due to (1) its flattened and pronounced kidney shape and (2) typical immaturity deformation of one side, usually owing to immature harvest.

stratigraphic sequence. The provenience of all Carbon-14 samples will be discussed in detail in the final report.

The two radiocarbon dates from Gakushuin (GaK 1845; 1846) appeared uncorrected in a previous short research report (Gorman 1969). The dates appear here corrected to a half-life of 5,730 years. Most of the samples were composed of bamboo charcoal; this has both advantages and disadvantages. In the northern Thai area bamboo, unless preserved, decays within a very short time; therefore, we can be fairly certain the dates are synchronous with cultural use. However, the presence of noncombustible silica often results in relatively high standard deviations. One sample from B3 Layer 5 (the Layer 4 and Layer 5 interface) was contaminated and had to be discarded. The only other sample from this lowest interface is still under analysis.

The most recent date, FSU 317, dates the bottom of Layer 1; this was a concentration of charcoal just above the surface of Layer 2. FSU 314 and GaK 1846 (corrected) both date the surface Layer 2. TF 802 and FSU 318 are both associated with Layer 2*a*, the charcoal-ash lens occurring within Layer 2. Although GaK 1846 yields an older date than either of these, it should be observed that all of these dates from Layer 2 (i.e., FSU 314, GaK 1846, TF 802, and FSU 318) occur in association with the same 5 to 20 cm layer; they represent 4 different samples analyzed at three independent labs, yet they all overlap within the second standard deviation.

No good charcoal samples were located in Layer 3. Samples were next available from the Layer 3-Layer 4 interface. GaK 1845 (corrected) dates this interface to $9455 \pm 360$ B.P. TF 803 comes from just below the Layer 3-Layer 4 interface. FSU 316 comes from just above the middle of Layer 4, and FSU 315 comes from a disturbed area containing primarily Layer 3-Layer 4 mixed soil. The date would indicate this charcoal material was actually *in situ* and little disturbed by the pit dug in above it from Layer 3. Samples now under analysis should supply reliable dates for the bottom portion of Layer 4 and the Layer 4-Layer 5 interface. The laboratories supplying these dates have stated them to be quite reliable; and, in general, the results fit well with the samples' relative placement in terms of the stratigraphic sequence.

## SUMMARY

Spirit Cave is a very small shelter, which, despite localized disturbances, has produced a well-defined stratigraphic sequence divisible into at least five soil horizons and two cultural levels. The radiocarbon determinations mainly from *in situ* charcoal deposits indicate that the shelter was occupied from about 12,000 years B.P. to about 7500 years B.P.; a time span of roughly 5,000 years. It is difficult to tell the exact nature of the shelter's occupation. The small hearths of Layer 5 would appear to be remains of nomadic campers. The Layer 4 deposit is quite homogeneous, is evenly distributed throughout the shelter, and may indicate a fairly continuous occupation. Layer 3 is primarily an ash deposition. Red lenses, occurring within the ashy matrix, appear to be due to the oxidation of soil immediately under fire areas. This may indicate large fires built upon relatively thin, and perhaps sterile, soil layers—a situation possibly brought about by a very occasional and, perhaps, specialized occupation pattern. The soil buildup of Layer 3 is primarily in the front central portion of the shelter. Layer 2 is similar to Layer 4 in that it is a homogeneous layer well distributed over the shelter floor.

From the surface of Layer 5 to the surface of Layer 2, there is very little change in the Spirit Cave lithic assemblage. The Pleistocene-Recent boundary that necessitated cultural readaptation in the higher latitudes can be chronologically placed somewhere during the deposition of the upper half of Layer 4. Associated plant and animal remains evidence no environmental change in the vicinity of Spirit Cave, and there is no evident technological readaptation.

## CONCLUSIONS

Layer 5 (surface) through to the surface of Layer 2 has been grouped together as Cultural Level I, designated from the presence of certain key traits as a subcultural assemblage of the Hoabinhian technocomplex. An edge-damage pattern analysis now underway should isolate functional types based on edge-damage characteristics. Cultural Level I plant remains have been discussed previously (Gorman 1969). The pattern of plant utilization indicated from these remains, in combination with ethnographic analogies from modern indigenous contexts within the area (Burkill 1935), suggests the exploitation of wild or tended nuts for food, for example, the butternut (*Madhuca*), the *Canarium*, and *Terminalia*; for lighting and possibly consumption, the candlenut (*Aleurites*); the pepper (*Piper*) as a condiment; and the betel nut (*Areca*) as a stimulant.

The bottle gourd (*Lagenaria*), the *Cucumis*, a cucumber type, the Chinese water chestnut (*Trapa*), and the leguminous beans, however, form a group of food plants suggesting a botanical orientation beyond simple food gathering. The leguminous plants are tentatively considered to represent early domesticated varieties. The lack of comparative prehistoric specimens hinders specific identification; however, on the basis of size, and from present botanical data on distribution and cultural use, we consider these as possible early domesticates. L. Kaplan (1965: 361) cites the increase of seed size as the main structural change associated with the domestication of *Phaseolus* in the New World. He considers an increase in size maintaining approximately the same ratio between size of the cotyledons and that of the meristematic embryo to be the best direct evidence of domestication (Kaplan 1965: 361). The seeds from Spirit Cave are very large; they will soon be dissected to examine their internal structure (Yen 1970, personal communication).

Faunal remains from both levels at Spirit Cave involve a considerable range of species. The range of environmental niches exploited extends from the Khong Stream to the ridge tops; the deer and pig bones point to a woodland hunting pattern, while the bat bones indicate the exploitation of the neighboring caves. The presence of bird and primate bones suggests arboreal exploitation (after Higham, n.d.).

Faunal remains were generally in an extremely fragmentary, uncharred state. The bones were not split lengthwise, and there is no other evidence that the bones were broken to obtain marrow. The presence of numerous hearths, the uncharred bones, and the heavy concentration of bamboo charcoal suggests that the animals may have been cut into small pieces and cooked (i.e., boiled) in large sections of green bamboo. There are numerous ethnographic examples of this practice in the area today.

The environmental niches and animal species exploited suggest more sophisticated hunting equipment than the lithic material would indicate. I doubt if the remains indicate scavenging practices, as in the tropical rain forests there are many better scavengers than man. I believe, as has been mentioned before (Heekeren and Knuth 1967: 107; Boriskovsky 1967: 43), that wood composed the most important component of the Hoabinhian technocomplex. The so-called conservative Southeast Asian pebble-core and flake-tool tradition may, instead of conservatism, reflect a tool specialization which occurred not on stone, but rather on wood. The concave damage patterns from Spirit Cave that suggest the working of small diameter (5 mm to 7.5 mm) wood shafts may well be relevant at this point. Work on reconstructing this possible wood component is now underway.

The surface of Layer 2 witnesses new traits in the area. This would indicate either a technological transformation occurring elsewhere in Southeast Asia within the Hoabinhian technocomplex, or entirely new and unrelated cultural elements diffusing into the Hoabinhian area. At Spirit Cave edge grinding (adzes and knives) and ceramics entered simultaneously as foreign elements into the continuing Hoabinhian expression.

The radiocarbon chronology speaks for itself, and there is no similar sequence available on mainland Southeast Asia for content comparison. Dunn's (1966: 352) date of 4800 ± 800 B.P. (GaK 0418) for the end of the Hoabinhian at Gua Kechil (Malaya) corresponds somewhat with the end of Spirit Cave occupation. Recent Carbon-14 determinations from the Thai-Danish excavation at Ongbah Cave, Thailand, fall within the range of the Spirit Cave sequence and are in association with a somewhat similar Hoabinhian assemblage (Sørensen 1969, personal communication). K. Chang (1967: 8) has suggested a date of around 11,000 B.P. for his somewhat similar, perhaps early horticultural, corded-ware expression on Taiwan. He mentions (1967: 8) that the 11,000 B.P. date is an average of two rather suspect dates; yet this date has been used several times (Dunn 1970: 116–117; Golson, forthcoming: 26; Solheim 1969: 9) to suggest early horticultural activity on Taiwan. Since the two dates averaged were 19,670 ± 450 B.P. (Y-1552) and 3080 ± 350 B.P. (Y-1496) (Chang and Stuiver 1966: 541; Chang 1969: 265–266), and as Chang (1969: 266) now lists Y-1496 as a contaminated sample, this 11,000 B.P. date should no longer be used. Chang himself (1969: 53) now simply refers to this assemblage as being at least as early as 4000 B.C. (see also White n.d.: 7, for a more specific discussion of this dating). Spanning the time period it does, the Spirit Cave assemblage is neither "Mesolithic" nor "upper-Palaeolithic." I suggest we abandon such terminology, and as G. Daniel (1965: 245) has suggested, describe what we excavate in terms of a local sequence and invoke a more suitable model for correlating these sequences (for such a model see Solheim 1970). The Hoabinhian, if accepted as a technocomplex, can, with more excavation, be extended to its proper dimension in space and time. In space it may already be reasonably extended; in time it may date well back into the Pleistocene and evidence a transform type of cultural change (Clarke 1968: 699) derived from an earlier early through mid-Pleistocene pebble-tool technocomplex.*

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