

Northern Thailand, Southeast Asia, and World Prehistory

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ABSTRACT

IN this article, I summarize the Thailand finds at Spirit Cave (domesticated plants before 9700 B.C. and polished stone tools and cord-marked pottery at 6800 B.C.); finds at Non Nok Tha (rice before 3500 B.C., a copper, socketed tool at 3500 B.C., and double-mold, bronze casting by 2300 B.C.); and supporting data from other Southeast Asian locations. Technological development for Southeast Asia from 25,000 to 1 B.C. is summarized, and a developmental framework for Southeast Asian prehistory and the spread of these developments follows. Southeast Asian contributions to world culture are cited, and I conclude with a brief discussion of the problems significant to world cultural change suggested by these developments.

INTRODUCTION

The preliminary reports on Spirit Cave by Chester Gorman and Non Nok Tha by Donn Bayard, immediately preceding this paper, present detailed data in site context for the first time for these two revolutionary sites. In order that this paper be complete in itself, I summarize finds of primary significance from the Gorman and Bayard reports, but remind the reader to refer to their papers for the substance of these sites.

Spirit Cave

The most astonishing finds from Spirit Cave were the plant remains which indicate that somewhere in this general area domesticated and tended plants were being grown for use as food, and other purposes, from before 11,690 B.P. Almost as surprising as the early dates for these plants are the kinds of plant remains found here together; *Piper* and *Areca* are not unexpected, but the *Cucumis*, Chinese water chestnut (*Trapa*), and the legumes are a surprise. Other plant remains found were *Prunus* (almond), *Terminalia*, *Phaseolus* (bean) or *Glycine*, *Raphia* or *Pisum* (pea), *Lagenaria*, *Madhuca* (butternut), *Canarium*, *Aleurites* (candlenut), and *Vicia* (bean). The association of plant remains with a typical Hoabinhian

assemblage was a surprise to most archaeologists until recently (Chang n.d.; Solheim 1967a), but had been suggested by the geographer Carl Sauer in 1952 (Sauer 1969). Several botanists have suggested the general area of mainland Southeast Asia and neighboring areas as among the most important and earliest regions of the domestication of plants (Vavilov 1951; Candolle 1883; Haudricourt and Hedin 1943; Burkill 1951-1952).

The Hoabinhian assemblage was found in all cultural layers of the site. In the top layer there was an additional assemblage added to the Hoabinhian; this assemblage included flaked and partly polished quadrangular stone adzes, ground and polished slate knives, and cord-marked, burnished, and incised pottery. Two Carbon-14 dates from charcoal associated with the entrance of these additional artifacts are 8142 ± 390 (FSU 314) and 8806 ± 200 B.P. (GaK 1846); we can call this date 8500 B.P. for simplicity (see also Gorman 1969).

Non Nok Tha

There have been four seasons' work at Non Nok Tha, in northeastern Thailand. The site was discovered by Chester Gorman in 1964 and was then referred to as Nam Pong 7 (Solheim and Gorman 1966: 176-177). In 1965 Ernestine Green excavated seven test pits, establishing the site as one of probable major importance. In 1966 Hamilton Parker, Donn Bayard, and I excavated in a portion of the site, establishing for the first time in Southeast Asia an extended period of bronze working and use without the presence of iron. The site was thereupon referred to as Ban Nadi (Solheim, Parker, and Bayard 1966; Solheim 1966, 40-41; 1967b-c). After receiving radiocarbon dates for this site we found that the bronze working was not only without iron, but that it was also much earlier than previously thought, not just for Southeast Asia but for all of the Far East (Solheim 1967d; 1968a; see also Bayard 1970: 42-47 for discussion of the Non Nok Tha radiocarbon dates). The fourth season's work in 1968 was by Donn Bayard, and the subject was that of the immediately preceding report. We now call the site Non Nok Tha, the local name of the mound making up the site. Non Nok Tha will hereafter be used for this site.

Non Nok Tha can conveniently be divided into three succeeding cultural periods. Stratigraphically they are as follows: *Pioneer*—Bayard's levels I through III and Parker, Bayard, and Solheim's 1966 lower and eastern upper Level I; *Adapted*—Bayard's levels IV through VII and Parker, Bayard, and Solheim's 1966 levels II through VII; *Contact*—Bayard's levels VIII through X and Parker, Bayard, and Solheim's 1966 levels VIII through XIII. (The terms I use to categorize these periods refer to Non Nok Tha alone and are not proposed as a terminological system for a number of sites in any given area. They are useful to me as a descriptive device for this site and may serve varying purposes concerning the area in northeastern Thailand with closely related sites that are all a part of one archaeological culture.)

Pioneer Period

The Pioneer period starts with the first occupation at Non Nok Tha (previous to the fourth millennium B.C.) and lasts until about 3000 B.C. There is considerable variety in the pottery with its decoration showing relationships with pottery to the west at Kok Charoen (personal observation; Bayard 1970: 57; Watson and Loofs 1967: 256 and Fig. 5—compare to Solheim 1967c: Pl. IIIb) and to the north at Ban Chiang (Bayard 1970: 58; Solheim 1970: Pl. IVa). During this period the people were becoming acquainted with the area and adapt-

ing their culture to the local ecological conditions. Agriculture was a part of their economy, with grain, probably rice, being the one known food plant. Rice is suggested by an impression of a rice husk in a sherd noted by Bayard from his Level I (Pl. Ia; Pl. Ib is a modern rice husk for comparison). This sherd would date before 3500 B.C. if our proposed Carbon-14 dated sequence for Non Nok Tha is correct. Large bovines represented in the burials probably provided an important part of the diet, and these animals may have been domesticated (personal communication, 1970, from Charles Higham, who is identifying our bone). The decorated pottery includes large pots with incised and impressed decoration around the rim and on the shoulder (Pl. Id; Solheim 1966: Pl. IIIc; 1967c: Pl. IVc-d; related to Kok Charoen pottery) and smaller painted jars (Pl. Ie; Solheim 1967a: Fig. 5; related to Ban Chiang pottery). Bone and shell beads are common with child burials, and small stone adzes are associated with some burials. No metal has been found in Bayard's levels I-II, but in Level III one copper socketed axe (?) was found with a burial, and two small fragments of copper were found elsewhere in this level. No indication of local manufacture has been found. The burial with the copper tool would date from about 3500 B.C.

Adapted Period

The Adapted period probably started at about 3000 B.C. and continued at Non Nok Tha until about A.D. 300. The culture, obviously closely related to that of the Pioneer period, now appears to be adapted to the local ecological conditions. There were possibly rapid and major changes in the pottery between the first and second, and second and third of Bayard's levels. By the second level of the Adapted period, painted pottery, never common at Non Nok Tha, was no longer made. The skillfully incised and impressed decoration was no longer produced, though very simply incised cord-marked pottery was made, unlike the previous decoration (Pl. If). While there was considerable variation in the pottery during this period, there was a decrease in variation from that of the previous period. Shallow bowls with ring feet were no longer made. The common form of funerary pottery from Bayard's levels V-VII first appears in Bayard's Level IV with the addition of a ring foot to a form of cord-marked pot common in earlier levels (Pl. IIa, b). These are large at first, but decrease in size through Level IV, reaching their later size in Level V (Pl. IIc). Smoothing of portions of cord-marked bodies (Pl. IId) begins, and red-slipping of portions of vessels (Pl. IIf) becomes common. Earthenware, probable spindle whorls (Pl. IIg) first appear in Level IV and are found thereafter. Beads become rare in Level IV and are not found above this level. Bovine bones are still a part of burials in Level IV but not thereafter, though they continue to be found elsewhere in the site. Bronze appears in Level IV with two pairs of sandstone molds, indicating that bronze is being worked at this site. This is earlier, probably by several hundred years, than the 2300 B.C. date I announced for our 1966 Layer 19 in which we found our deepest bronze, but below which, on top of Layer 20, we found two pairs of sandstone molds (Solheim 1967d and 1968). Bronze tools, small scattered nodules of bronze, crucibles, and bronze bracelets are present from 1966 levels III through VII and Bayard's levels V through VII. The small, polished stone adzes continue through these levels as well, becoming slightly more plentiful in the upper levels of this period. Burials during the Pioneer period varied considerably in orientation and associated artifacts, though they were always supine extended. In Bayard's levels V-VII the burials for each level are much more standardized with an accepted orientation of the body, position of hands, and type and position of burial furniture.

Contact Period

The Contact period follows the Adapted period after a considerable gap, beginning at about A.D. 1000 or later, and continuing until about 3–200 years ago. The culture in this period is an obvious continuation from the earlier period but with additions and changes indicating increasing contact with foreign cultures. The cord-marked pottery presents the major evidence for this being a continuation of the earlier culture. Other portions of the culture have changed drastically. Inhumation is no longer practiced but is replaced by cremations, in jars, buried in small pits beneath the houses. Post holes found in Adapted period levels indicated houses on piles, somewhat larger than the houses indicated for the Contact period, the latter being very close to the size of modern houses in this area. Tanged, iron tools are now common, and bronze and stone tools are rare. Remains of large meat animals are rare, while fowl and pig bones are more common. Non-local earthenware pottery is present, though not in large quantity, and occasional sherds of stoneware, celadon, and low quality porcelain are found. There are general similarities between the culture of this period and that found today at Ban Nadi; however, the pottery shows very little similarity. In the history of the local people, their ancestors came to Ban Nadi from nearby in 1894 and found no indications of previous occupation at that time. Bayard suggests the present Lao-speaking population has been in this general area for about two hundred years.

Supporting Data from Elsewhere in Southeast Asia

The data from Spirit Cave are internally consistent and strongly mutually supporting. No other Hoabinhian site has produced plant remains, but it is likely that no earlier workers looked for such remains and they therefore went unobserved, even though they were present. The late added assemblage of quadrangular, partly polished adzes, polished slate tools, cord-marked and incised pottery is supported by the similar assemblage from Formosa, undisturbed and well below levels with Carbon-14 dates at around 2500 B.C. (Chang 1966: 141–142; 1969; Solheim 1969: 130–131).

The datum needing support at Non Nok Tha is the radiocarbon dated sequence. While the considerable period of bronze working without iron was until recently unreported elsewhere in Southeast Asia, such bronze finds are now indicated for North Vietnam (Van Tan 1964: 208–209) and South Vietnam, though when this work may have started is not yet known. There are very few radiocarbon dates that are associated with bronze in Southeast Asia. Besides those dates from Non Nok Tha, one of the more secure dates is considerably earlier than the rather widely accepted dates for the Dongson bronzes of 300 B.C. and later.

The site of Hang Gon I in South Vietnam indicates bronze working without iron (Saurin 1962; 1963: 452). A fragment of one mold (Saurin 1963: plates XXVI–12, XXVII–1) is similar to some of those found at Non Nok Tha. Other evidence of local bronze working was also found at this site (Saurin 1963: 444–446). Saurin reports a radiocarbon date for this site of 3950 ± 250 B.P. from charcoal fragments in potsherds. He feels this is unexpectedly old but can see no reason for contamination of the charcoal (Saurin 1968: 3).

Negative supporting evidence is also available, suggesting that the traditional dating for Dongson bronzes is either wrong or does not apply. North Vietnamese data indicate that there were two or more bronze-working cultures in North Vietnam. The bronze-using

culture at Viet Tien is judged to be earlier than Dongson, and the bronze artifacts from there are "...totally different from the finds at Dong Son" (Van Tan 1964: 209). The more widely accepted theory for the source of bronze manufacture in Southeast Asia is that it came from Chou China and initially, therefore, Chinese methods, if not Chinese workmen, would have been used. Both Noel Barnard and William Watson, experts on early Chinese bronze manufacture, have told me in correspondence that the crucibles and kinds of molds we have at Non Nok Tha show no relationship to Chinese methods of casting bronze, and that the two systems are independent of each other. Thus, the dating of the small socketed tools is completely open. Because several of this kind of socketed tool were found at Dongson it has been assumed that all such tools, wherever found, are Dongson tools. These axes have been found widely scattered in Southeast Asia, and where their context is known, very often they are not associated with any other distinctive Dongson artifacts. Doubtless the correct interpretation for the Dongson bronzes is that they are a late manifestation of a long established bronze-working tradition within which the large bronze drums and related artifacts became somewhat of a fad and incorporated a certain number of foreign elements; but they expressed as much or more that was traditional in Southeast Asian culture. Finally, in a summary article of the prehistory of a small area of South China, near Hong Kong, Raphael Maglioni hypothesized that bronze working in that area was earlier than in North China (Maglioni 1952: 9-10) and that the PAT people of this area introduced bronze manufacture to China. Unfortunately, Maglioni's major manuscript, presumably with detailed data supporting his hypothesis, has never been published.

SOUTHEAST ASIAN CULTURE HISTORY

I have recently presented my ideas on the prehistory of Southeast Asia as an alternative to the reconstruction presented by R. von Heine-Geldern (Solheim 1969; Heine-Geldern 1932) and am now in the process of writing a book on this subject. There is no need here to go into detail on the culture history of Southeast Asia, but the framework of this cultural development is important in this context to move from the data for northern Thailand into the rest of Southeast Asia and from there to the world as a whole. In presenting this framework I am able to include some new data that have come to my attention since writing the *Paideuma* article. As I am concerned with relating the data from northern Thailand, I begin with the Hoabinhian and do not go further back to the middle Palaeolithic chopper-chopping tools. Parts of the following framework are conjectural.

Technological and Economic Development

Early Hoabinhian

I do not attempt to deal with early Hoabinhian archaeologically. It developed directly out of the chopper-chopping-tool tradition, and it will probably be extremely difficult to find a satisfactory boundary which clearly differentiates the culture on one side from that on the other. The change probably took place in a cultural continuum with little if any contact with people outside of Southeast Asia, except along its area boundaries. Eventually dating the early Hoabinhian back 50,000 years B.P. would not surprise me. A geological date might provide a convenient, arbitrary boundary. A mild period during the final glaciation is indicated in the northern Indian Ocean between about 42,000 and 22,500 B.P. (Frerichs

1968: 1456-1457). This stadial probably had some effect in northern Southeast Asia and may well have raised sea levels slightly so that there was a change in coast lines, particularly in Island Southeast Asia. These changes probably led to some movement of small groups of people and to some readaptations in their cultures. The beginning of this mild interval could provide a convenient point to place the boundary from which to start the early Hoabinhian.

Middle Hoabinhian

I have suggested before that the middle Hoabinhian might be a useful subdivision of the Hoabinhian and would be distinguished from early Hoabinhian by the beginning of edge grinding on one type of Hoabinhian tool (Solheim 1969: 130-131). The earliest reported dates for this kind of tool come from Arnhem Land in northern Australia where it is dated at about 20,000 B.P. (White 1967). I had suggested edge grinding as beginning earlier than 12,000 B.P. (Solheim 1969: 130-131). I would now suggest that edge grinding began around 25,000 B.P., somewhere in Southeast Asia. With the end of the mild interval in the northern Indian Ocean by about 22,500 B.P. (Frerichs 1968) and movement of sea levels back to the lower level, man would again have moved into newly available areas, including the south, bringing with him into Australia portions of the Hoabinhian industry including the edge-ground axes (White 1967: 150).

Life must have been relatively easy and hunting of some importance, but the gathering of forest plant products and of water animals was of primary importance. With a small population that was apparently expanding slowly, a family would not have had to move around constantly but only a short distance to an area where its gathering practices had not depleted the streams or seaside. The gradual expansion of population would have influenced continuing gradual movement into new areas, in a manner similar to the postulation by A. Yengoyan (1967), but involving movement always into areas close to streams or seashore. In somewhat richer areas the population probably remained generation after generation, becoming extremely well acquainted with the local area and developing slightly differing cultures. The concept of the technocomplex, as suggested by Gorman for the Hoabinhian differentiation, would seem to be very appropriate (Gorman 1970). New cultural elements originating in one area would gradually spread through other portions of the Hoabinhian technocomplex, but differences between them would be noticeable and no two subcultures within the technocomplex would share all the same elements. The increasingly strong acquaintance of the people with the plants and animals of their area would imperceptibly bring them into an era of incipient domestication.

Late Hoabinhian

I have suggested that late Hoabinhian came into being sometime between 12,000 and 10,000 B.C. (Solheim 1969: 130). This is simply a stage in the development of the Hoabinhian technocomplex, and it began in different sectors of the technocomplex at different times. Altering my earlier suggestion, I now say that the late Hoabinhian was coming into existence here and there in Mainland Southeast Asia between 15,000 and 10,000 B.P. I would consider either of two cultural elements—the manufacture of cord-marked pottery or the domestication of one plant or animal—as diagnostic of the late Hoabinhian. During this time span a number of plants were cultivated and probably the dog and chicken were domesticated. Different plants were no doubt cultivated in different areas at different times, and I doubt that there

was a center in which any more than two or three plants were domesticated. At any one time it is quite possible that no two of the subcultures of the technocomplex shared even most of the domesticated and tended plants, stone tools, and elements of pottery manufacture and decoration. For example, in its earlier levels Spirit Cave lacks edge polishing and pottery but has a considerable number of plants.

Spirit Cave also brings up several problems. A logical result of polishing that extends over the total Hoabinhian edge polished tool is the oval and lenticular adze, which was early in Southeast Asia. Where did the rectangular adze come from? Did it somehow develop out of the oval adze, or did it come from the outside? The flake tool, which was developed quite early, is another problem. Gorman reported flake and blade tools as a part of his Hoabinhian assemblage. Very likely flake tools were important at other Hoabinhian sites but were disregarded (though mentioned as stone flakes) by the excavators because they did not come in patterned forms similar to the flake tools of the West. H. R. van Heekeren and E. Knuth reported flake and blade tools from Sai-Yok in western Thailand associated with a Hoabinhian assemblage (van Heekeren and Knuth 1967: 37-38). Scheans, Hutterer, and Cherry (1970) establish the presence of flake and blade tools in Samar (Philippines) in the article following this one, and Warren Peterson has reported (1969, personal communication) blade tools from the east coast of Luzon (Philippines). The flake tools could well be another facet of the Hoabinhian, but at Tabon Cave in the Philippines (Fox 1967: 99-104) and in Niah Cave in Sarawak (Eastern Malaysia; Harrison 1959: 1) there are flake tools without the typical Hoabinhian tools. Do these flake-using cultures have an early Hoabinhian origin, or are they unrelated? Are there racial differences associated with these different tool assemblages? There must have been racial differences, but I doubt that they were closely correlated with different stone-working traditions.

Some of the late Hoabinhian subcultures probably continued until the fourth or fifth millennium B.C., but with the developing custom of polishing over the majority of the surface of the stone tools, possibly some of these subcultures were no longer recognizable as Hoabinhian by 7000 or 8000 B.C. If the rectangular adze was developed in a Hoabinhian culture, the assemblage that was added to the Spirit Cave Hoabinhian (and the Corded-Ware culture of Taiwan) was no longer recognizable as Hoabinhian sometime before its appearance in Spirit Cave at 6500 B.C.

Cord-marked pottery has been widely found in the upper levels of Hoabinhian sites. The manufacture of cord-marked pottery could have been invented in one of the subcultures of the Hoabinhian technocomplex, or it could have been borrowed from another, as yet unknown, culture. Whichever the case, probably by 6000 B.C., distinct middle Neolithic cultures were developing with different stone tool kits and different pottery. These cultures probably all shared the method of paddle-impressed cord-marked manufacture of their most common pottery but were developing different sets of forms. These cultures were also moving in different directions in the decoration of their pottery. Some cultures were incising decorations (Spirit Cave and the Corded Ware culture of Taiwan) and some were painting ("Yangshao," Ban Chiang). From the few indications we have at present for dating these cultures it appears that the painting of pottery developed later than incising. There is a thermoluminescent date from Ban Chiang of 4630 ± 520 B.C. (P-T 104; Chin You-di, personal communication, 1970). From this date and the presence of two painted jars from around 3500 B.C. at Non Nok Tha with two or three levels below them, and rice or some kind of grain indicated in the deepest level, I suggest that the painting of pottery and the growing

of a domesticated grain were both present in northeastern Thailand by 5000 B.C. The early "Yangshao" painted pottery is possibly from the same time, with a common origin.

The working of copper into socketed tools was probably being done in Southeast Asia by 4000 B.C. Mrs. Phuangsinsuwanarat, of the Department of Mineral Resources of Thailand, examined two samples from the copper tool found by Bayard (1970) and reported that, besides copper, they contained aluminum, iron, phosphorus, and traces of arsenic and mercury. She further reported that the bit of the axe showed that it had been cold hammered. F. C. Thompson (1958) reports that copper which can be cold worked is of high purity and is ordinarily found in the form of native copper, malachite, or a pyritic ore. According to Richard Pittioni (see Addendum) malachite is available not far from Non Nok Tha, and copper could have been cold worked in this area. However, the presence of iron and other impurities in more than traces strongly suggests that the copper came from an ore that had to be roasted before sufficiently pure copper was available for tool manufacturing by cold hammering (Thompson 1958: 4). Therefore, even if this axe was not cast (and it may have been) it indicates the beginnings of metallurgy already developed beyond the initial stages. There is a good chance that cattle was domesticated by 4000 B.C. and that grain, probably rice, was almost certainly being grown by then. It is likely that the outrigger canoe had been invented by this time and that Southeast Asians were beginning to move out into the South China Sea. Ian Glover suggests that between 2500 and 3500 B.C. "... pigs, pottery and probably agriculture were introduced into Timor..." (Glover 1969: 111). It is unlikely that Timor could have been reached by these mainlanders before they had spent considerable time growing accustomed to sailing and to preliminary exploration. I expect that it was about 4000 B.C. when Southeast Asians first made contact with Japan.

Bronze working, socketed, cast axes, and other tools using double molds had probably been invented in Southeast Asia by 3000 B.C. The working of bronze, as suggested by the evidence from Non Nok Tha, probably included a system of trade to distribute workable bronze. The scattered nuggets of bronze found at Non Nok Tha are probably splatters of bronze from the casting (see Pittioni, Addendum). Several of the bronze objects from Non Nok Tha were examined by Cyril Stanley Smith. While we do not yet have his final report, he has made the following general comment on the basis of his research so far: "The metallurgy represented by these rather simply shaped objects is by no means primitive, and corresponds to that of the Middle East a little before 2500 B.C. However, Middle Eastern finds would include far more copper and copper-arsenic alloys than bronzes at this time, and the high-tin hot worked alloy did not appear there until much later. The presence of tin in all samples is quite unusual" (Smith, personal communication, 1969). No evidence of ore of any kind or of smelting was found at Non Nok Tha in the bronze-working area. This suggests that preliminary refining was done elsewhere, probably near the source of copper ore. Lead ore (the Non Nok Tha bronze is high in lead; see Addendum) is also available in northeastern Thailand not far from the copper (United Nations 1968: 42, 48), but tin had to come from further afield: either about 250 km to the northeast just across the Mekong, or about 450 km northwest in Chiangmai or Chiangrai Provinces (United Nations 1968: 42, 48).

The major new activity of the fourth and third millennium B.C. was the movement of people around Island Southeast Asia. Possibly with added impetus from the availability of bronze tools, but certainly with the growing use of domesticated plants and animals, the rate of population increase had apparently speeded up so that more land was needed more rapidly. By the second millennium B.C., the Southeast Asians must have been moving around

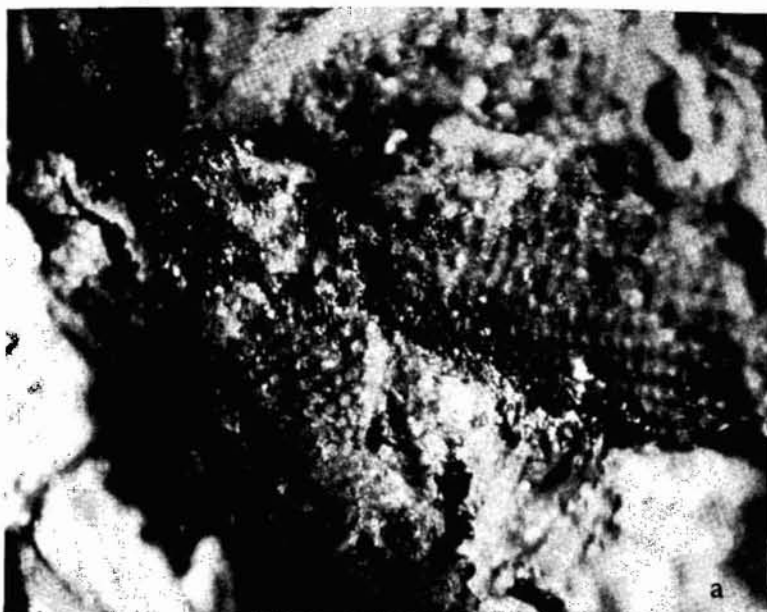


Plate I *a*, impression of a rice husk from a potsherd (Non Nok Tha 453) dated before 3500 B.C.; *b*, modern rice husk from northeastern Thailand; *c*, carbonized grain of rice (NNT 375, ca. 5 mm long), from Bayard's lower Layer 6.

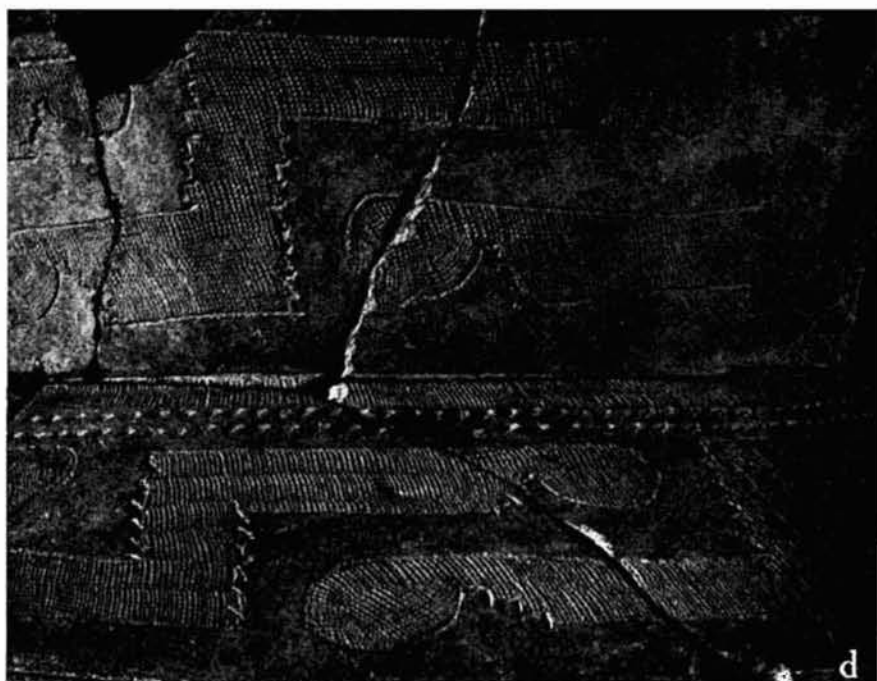


Plate Id (top) large incised and impressed jar (NNT 153, max. diam. 52 cm) and (bottom) detail of decoration, from Bayard's Layer 9.

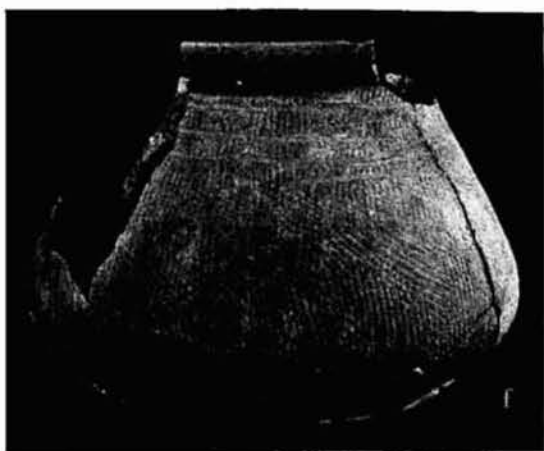


Plate I *e*, painted jar (NNNT 629, total ht. 23 cm) from Bayard's Layer 7; *f*, pot with incising over cord-marking (Nam Pong 346, max. diam. 18 cm) from 1966 Layer 21.



Plate II *a*, type of early cord-marked jar (NP 334, max. diam. 21 cm) from disturbed area, possibly 1966 Layer 17; *b*, cord-marked jar with ring foot (NP 466, total ht. 16 cm) from 1966 Layer 21.

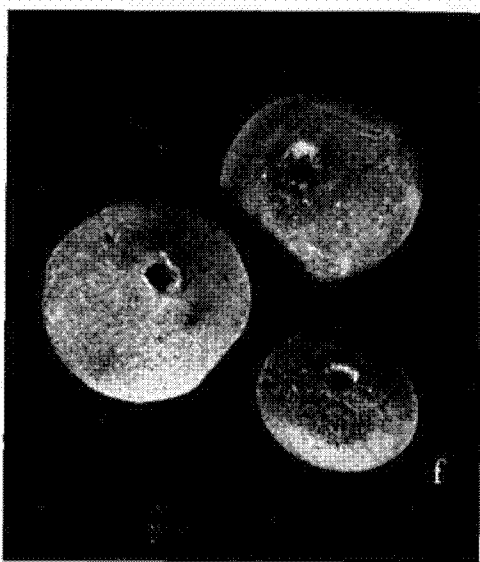
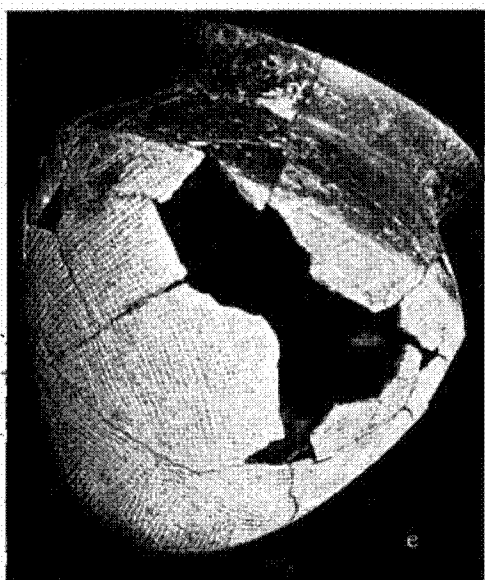
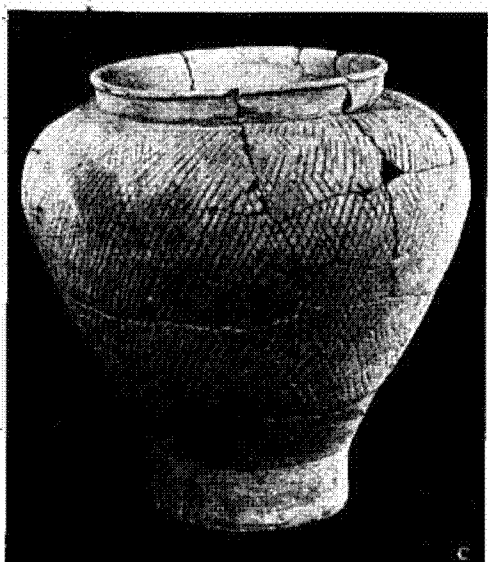


Plate II *c*, cord-marked jar with ring foot (NNT 369, total ht. 15 cm) from Bayard's Layer 7; *d*, partly smoothed cord-marked jar with ring foot (NP 324, total ht. 15 cm) from 1966 Layer 21 (?); *e*, jar with cord-marked body and red slip on shoulder and rim (NNT 606), Bayard's Layer 7; *f*, earthenware spindle whorls (NNT 198) from Bayard's Layer 5.

all the interior waterways from Taiwan to the Andaman Islands and were moving out into the Pacific, at least into Melanesia. There is less evidence for expansion to the west, but movement along the east coast of India to Ceylon and possibly farther must have been going on as well. One of the social specializations that probably evolved during the second millennium B.C. led to a group of trading boat-people similar in some ways to the Sea Gypsies who used to be common along the coasts of Malaya.

Iron working developed during the first millennium B.C. A thermoluminescent date from a site near Lopburi in which iron tools were found all the way to the bottom gives a 700 ± 166 B.C. (P-T 103; Chin You-di, personal communication, 1970) reading. Survey and testing by the Fine Arts Department—University of Otago—University of Hawaii expedition in early 1970 produced a site a few kilometers west of Non Nok Tha in which two socketed iron tools were found, cast in typical bronze forms (Terry Marsh, personal communication, 1969). It appears that there was an early development of iron working in Southeast Asia directly out of the bronze traditions. The presence of rust cakes in so many sites associated with what were called Dongson bronzes is very likely not an indication of the lateness of the Dongson bronzes but rather an indication of how early iron came into use in some areas of Southeast Asia. Again, diffusion did not distribute iron-working techniques evenly. Iron was apparently not being used at Non Nok Tha before A.D. 300, the beginning of the gap between bronze and iron there. With the Non Nok Tha gap I stop my framework of prehistoric development in Southeast Asia.

Cultural Relationships

I proposed a developmental scheme for the prehistory of Southeast Asia in my *Paideuma* article (Solheim 1969: 137), where I divided man's prehistoric presence in Southeast Asia into five stages. Already I must make one change and suggest a refinement of two of these stages. I see the five stages, with newly added substages of the final two stages, as follows:

1. *Lithic* starts with the entrance of early man in Southeast Asia, coming in from the west or evolving locally (whichever way it may turn out to be). Equating *Lithic* with the traditional terms, it would equal the Lower Palaeolithic and the Chopper-Chopping-Tool tradition.

2. *Lignic* begins with the early Hoabinhian, for which I suggested the arbitrary boundary of the beginning of the final mild stadial of the last glaciation, at about 42,000 B.P. The name, suggesting the use of wood for tools, is based on the suggestion that I and others have made that the Hoabinhian was not a period of cultural stagnation in Southeast Asia. It was not characterized by very slow culture change because of the lack of contact with other cultural regions—an idea which can be supported by the failure of fine stone-flaking techniques like those of the West to develop. I feel that in place of stone, wood—particularly bamboo—became the more important material for many kinds of tools. This theory has not been proven, nor even tested archaeologically, so *Lignic* must remain a somewhat tentative name for this stage. Traditional stages equating the *Lignic* are the Upper Palaeolithic plus early Hoabinhian but would include the unnamed flake (including blade) tradition that is now beginning to show up.

3. *Crystallitic* cross-cuts traditional stages even more than does the *Lignic* in that it brings together incipient cultivation and early horticulture. This is a stage when distinct cultures are crystallizing out of a roughly common base. *Crystallitic* begins with the middle Hoabinhian at about 22,500 B.C., during which incipient horticulture was developing, and it

ends with the late Hoabinhian, an early neolithic techno-complex. It would include the continuation of the unnamed flake tradition, which I assume shared in the domestication going on among the Hoabinhian subcultures. During this period both plant and animal domestication took place.

4. The *Extensionistic* stage does not have the advantage of an arbitrary date for its beginning as the two earlier stages do; it is a different sort of concept. This stage began at different times in different places when individual late Hoabinhian subcultures evolved into distinct archaeological cultures that can no longer be considered Hoabinhian. The first one of these cultures may be recognizable as early as 10,000 B.C. if Chang's Corded-Ware culture entered Taiwan before the lowering of the sea level at the end of the last glaciation. In any case the first of these cultures must have been clear by the eighth millennium B.C. as the distinctive assemblage that came in at Spirit Cave around 6500 B.C. probably required development of several hundred years before its appearance there. The Extensionistic is a time of population expansion and movement, at first on land, and by 4000 B.C. over water in the outrigger canoe. This might be the time that the Corded-Ware culture entered Taiwan. Included here are middle and late Neolithic cultures. Bronze working developed in Southeast Asia out of copper working, which may also have been invented in Southeast Asia or may have come in from the west. It is during this time that movement went on into and through Island Southeast Asia, out into the Pacific, and probably into and around the Bay of Bengal.

Here I must make a change and a refinement to my earlier five stages. I had previously included the beginnings of iron in the fifth stage. I now feel that iron became important well before Indian contacts affected Southeast Asia. A report by Bennet Bronson (to appear in *AP XV*) on the work in Thailand by the University of Pennsylvania suggests that sizeable village communities, with iron, were developing in central Thailand during the first millennium B.C. The pre-Khmer settlement at Phimai, in northeastern Thailand, very likely goes well back into the first millennium B.C. (Solheim 1965) and certainly appears to be more than a simple farming community. The exploration and testing south of Sarin (northeastern Thailand) by the Fine Arts Department-University of Otago-University of Hawaii expedition in early 1970 found several iron-using, pre-Khmer, large settlements with rich deposits over 5 m deep (Charles Higham, personal communication, 1970). The Thailand National Museum excavation near Lopburi seems to be finding much the same kind of settlement.

For the time being I am considering this iron-working, village-town development as a distinct subdivision of the Expansionistic. As excavation in new sites and publication of reports on these sites becomes more common, undoubtedly we will need to make this subdivision a primary stage of its own.

5. *Conflicting Empire* is a period that can be defined with dates. While many cultures in Southeast Asia were not a part of one or another of these "empires" they were to a greater or lesser extent affected by them. The first of these "empires affecting Southeast Asia" is Han China when it entered North Vietnam. It could be argued that Late Chou China was the first to affect Southeast Asian cultures, so I arbitrarily exclude it. It is a part of the complex interrelationship between the developing cultures of the two areas that I will discuss below. Indian influence, leading to a different kind of political organization from the indigenous Southeast Asians', started coming in not long after the entrance of Han China. The early portions of this period might be considered Protohistoric and the latter portion

Historic, and it would probably be well to divide the period into these two subperiods. The further subdivision of Historic Conflicting Empire into Internal Conflicting and External Conflicting would mean that the total period came to an end (hopefully) with the end of the colonial empires following World War II.

External Relationships

The external relationships of Southeast Asia with neighboring areas were probably very important to both Southeast Asia and to the outside areas, but all we can do is to suggest where research is needed to answer questions as to the influences and the directions in which these influences were moving.

The major question is the relationship between developing China (and Japan) and Southeast Asia. K. Chang has discussed this relationship in some detail, and he presents the problem in much the way that I see it (Chang 1970). At the time Chang wrote the article he did not know of the pre-10,000 B.P. dates for Spirit Cave, but these dates do not make any difference to his arguments. The only real question to the early domesticated plants found in Spirit Cave is the botanical identification, which has been questioned by Jack Harlan, a plant geneticist (Ho 1969: 33). The only way to answer Harlan's questions is to find more samples by further excavation so that there will be enough plant remains to send to several experts for identification. The first question concerning China is the relationship of the "Yangshao" cultures to the Hoabinhian. It is hypothesized that the "Yangshao" pottery was developed out of an early neolithic cord-marked pottery, which could well have been made by a late Hoabinhian subculture. Early Japanese pottery (while not the earliest in Japan) is also cord-marked, though this cord-marking was made by rolling a cord down the side of an unfired vessel while the mainland cord-marking was done by beating the unfired vessel with a cord-wrapped paddle. The earliest dating at present is about 8000 B.C. for the Japanese cord-marked pottery. The earliest dated pottery on the mainland is that from Spirit Cave. Much more excavation will be needed to answer the question of first pottery manufacture in East Asia and the relationships among the Hoabinhian, "Yangshao," and Early Jomon pottery and people. South China, south of the Tsinling Mountains, is probably vital for the answer to this question.

The next major question in Southeast Asia-China relationships is the domestication of rice. Ping-ti Ho argues convincingly for rice being grown earlier in China than in India (Ho 1969: 20). Though he did not take Southeast Asia into consideration in the main body of his article, in a postscript Ho looks at the plant remains reported from Spirit Cave and considers that possibly horticulture originated in Southeast Asia; but he maintains that grain-centered agriculture of the Far East began in North China (Ho 1969: 34). The evidence at present tends to support Ho with respect to growing *Setaria* and *Panicum* millets (Ho 1969; Chang 1970). However, the growing of rice is still a question. The earliest grain impression from Non Nok Tha, which we think is rice (impressions and one carbonized grain, Pl. Ic, dating about 1800 B.C., are with Professor H. Kihara, of Japan, for identification), dates from sometime before 3500 B.C. and is very tentatively related to the "Yangshao"-like painted pottery of Ban Chiang. Chang (1970) suggests "... a date in the fourth millennium B.C. for the earliest Lungshanoid on the mainland, making the Lungshanoid rice remains the earliest known." The question is far from settled.

The questions of the origins of pottery and rice and the directions in which they might have moved are specific, but they are only examples of the many similar questions that will

come up as we try to work out the relationships between North China and Southeast Asia. Without question, both areas were innovating and profiting greatly from the diffusion going on between the two areas. The third millennium appears to be the time when China started to centralize political power while Southeast Asian cultures apparently continued on the old path without centralization of power.

The relationships between Southeast Asia and India and the areas farther west are even more difficult to deal with specifically than those with China and, for the most part, require more research simply to frame specific questions (Solheim 1967a).

SOUTHEAST ASIA AND THE WORLD

Contributions from Southeast Asian cultures to the rest of the world may prove to be overwhelming (relative to previous and current opinion on this subject) once we have done enough excavation and analysis to date specific elements. At the moment the best evidence of this contribution is from the botanists. Chang has translated a paper by Hui-lin Li listing cultivated plants originating in North China, South China, Southern Asia (Burma, Thailand, Indochina) and Southern Islands (Malay Peninsula, and the Malay Archipelago) (Chang 1970). When one combines those plants listed from what I consider as Southeast Asia (south of the Tsinling Mountains) the list is awesome. Chang adds to this list a number of bamboos, broad beans (*Vicia faba*), and the peanut. The latter two have been found in Lungshanoid sites, and of course a *Vicia* was reported from Spirit Cave. Chang remarks that "The bottle gourd (*Lagenaria vulgaris*) figures prominently in the creation myths throughout Southeast Asia and must have been in use in the region since antiquity" (Chang 1970). *Lagenaria* was also recovered from Spirit Cave.

The little information we have on metallurgy from Non Nok Tha (early dates, copper before bronze before iron, socketed tools, double molds before 2300 B.C.) suggests that there was a local evolution of metallurgy in Southeast Asia. The first site for which these have been dated is most unlikely to have been the original, or even an early site for these developments or spread of these methods, as the early sites would be rare. Thus it is distinctly possible that there was either an independent invention of metallurgy in Southeast Asia, or that it was here that heat working of metal first took place and spread to the West.

China has long been considered the first civilized country in the Far East and the source of much of the technological and economic portion of Asian cultures, outside of India. The archaeological finds in northern Thailand throw some doubt on these assumptions. Paul Benedict's "Austro-Thai Studies: 3; Austro-Thai and Chinese" (Benedict 1967) questions the same assumptions. Benedict's conclusions are controversial, but they deserve careful study. In earlier publications he has reconstituted what he calls the Austro-Thai language stock (Benedict 1967: 277). He has then compared words in this language stock to the same words in Chinese. As a result he suggests that many of the words that were thought to be loan words from Chinese to Thai are actually loan words from Austro-Thai to Chinese. Benedict summarizes this study as follows:

The AT loan-words in Chinese, when viewed as an ensemble, constitute the outlines of a substantial material culture: the higher numerals (above 100); the fowl and egg (and perhaps the duck); horse, saddle, and riding; elephant and ivory; the pig and rabbit (but not the dog); cattle and goat/sheep; the bee (curiously prominent in this material) and

perhaps honey; garden and manure; plough; mortar and hull grain with pestle; seed, sow, and winnow; rice (various, including cooked rice) and sugarcane (whence sugar); banana and coconut; ginger and mustard; the dipper (made of a coconut or gourd), ladle, and vessel (container); salt; smoking (meat) and steaming (rice); bait (meat) and net; metals (gold, copper, iron, tin/lead); the ax; ladder/stairs; boat, rafts, and oars; washing (metals and rice); hunting (but not the bow or arrow); crossbow (but precise origin unknown); fireplace, kiln, and pottery; weaving and plaiting (twisting rope); the needle and embroidery; basket and bag; indigo; cowry (=money); market, price, and sell.

To summarize the above discussion, the linguistic evidence as a whole points conclusively to an extensive cultural contact between the early Chinese and AT peoples. Aside from the lower numerals (1 through 100) and perhaps some other roots, notably those for "silver" and "goose," the process was essentially unidirectional, with the Chinese as the recipients rather than the donors. (Benedict 1967: 316-317, 323)

Jack Sawyer and Robert Levine made a factor analysis of a world ethnographic sample. From this research they say "The similarities in correlations found across cultural regions—between at least some of which little diffusion has apparently occurred—argue against diffusion as a sole cause" (Sawyer and Levine 1966: 728). This statement says to me that their data indicate that diffusion is the primary cause, if not the sole cause. Sawyer and Levine (1966: 726-727) found that the most prominent and central geographic cluster shown by their analysis was South America, Insular Pacific, East Eurasia, and Africa, and they feel that this cluster cannot result from contact and diffusion.

I questioned the foregoing theory, feeling that this is a logical cluster that possibly resulted from contact and diffusion through Southeast Asian peoples. "Unfortunately, Southeast Asia was broken up between East Eurasia and Insular Pacific (Sawyer and Levine 1966: 720) so its position as a properly independent region cannot be judged" (Solheim 1968b: 569). I strongly suspect that if the Sawyer-Levine study were reworked with Southeast Asia as a separate region, the clustering would be even more pronounced, with Southeast Asia in the center.

What strikes me as the extreme suggestion was made by Benedict when he said that there were indications in the examination of loan words that writing diffused from Austro-Thai to Chinese (personal communication). It is unlikely that we will find physical evidence of this unless we also find scapulimancy in Southeast Asia; later Austro-Thai writing was traditionally on leaves or bamboo, which simply would not last.

Problems of World Significance

There are by far more problems in Southeast Asian prehistory than there are answers. The questions on the domestication of plants and animals and of metallurgy and of their spread, if they came as early as I hypothesize, are of world significance.

There is one complex problem, however, that potentially is of even greater significance. That has to do with the development of political and social organization and urbanization in Southeast Asia. If the domestication of plants was well underway by 10,000 B.C., why was population expansion so slow? If rice was being grown at Non Nok Tha in the fifth millennium B.C., why didn't the growth in population that was apparently taking place in

Southeast Asia, with rice as a food source, proceed as it did in China? In China, along with the population explosion, indicated in the Lungshanoid expansion, came the concentration of political power, urbanization, and warfare (Chang 1968: 121-160). In Southeast Asia, at Non Nok Tha and other sites, apparent differences in individual wealth or prestige or both are indicated by considerable differences in the quantity of grave goods. By 3000 B.C., after a long period of gradual development, very possibly all the elements that one may presume are needed for civilization were present (agriculture, metal working, trade, writing?) but there is, as yet, no indication of urbanization. We have an indication of urbanization in northeastern and central Thailand by the first millennium B.C. and possibly earlier, but as yet, no indication of warfare, at least on any large scale. We have evidence of six or seven distinct (as far as pottery is concerned) cultures in Thailand during the first millennium B.C. How can cultures be so close to each other and yet retain separate identities over at least several hundred years? On the surface it looks as though a live-and-let-live philosophy existed that does not seem to have been a part of any other civilization for any considerable period of time. It may be that once we acquire more data on this indigenous, pre-Indianized urbanization we will find that these towns definitely were not living in peaceful coexistence; but if they were not, why do we see now, though faintly, six or seven distinct towns existing over several hundred years without indications of interference with each other?

ADDENDUM

Spectro-analytical Research on Bronze from Northeastern Thailand

By Richard Pittioni; translated by Karl Hutterer

In the fall of 1967 Wilhelm G. Solheim II handed over to the Institut für Ur- und Frühgeschichte of the University of Vienna archaeological material from his excavations in northeastern Thailand with a request that spectrographic analyses be done. The recovered material consisted of bronze and iron objects. The latter were excluded from analysis, since previous experience has shown that spectrographic analysis of iron does not produce useful results. The vast majority of the remaining bronze objects were small lumps and droplets that resulted from splatter during the casting process. Because of their heavy corrosion it was feared that these objects might be destroyed in the electric arc and they were, therefore, also eliminated. It was thus necessary to limit the analysis to compact and well-preserved specimens. The analyses were carried out by H. Neuninger according to the method developed by him.

The 15 spectro-analyses (Anal. Nos. 5286-5300) in Table I have reference to objects from burial and habitation sites in the area of Nam Pong, specifically sites at Non Nok Tha and Pimai. (Cf. Solheim 1967*a*, 1968*a*. With regard to the dating of the analyzed objects, it may be remarked that they can hardly be put before the eighth century B.C.) According to W. G. Solheim II, Non Nok Tha is situated about 80 km northwest of Khon Kaen in northeastern Thailand. This would be about halfway between Phetchabun and Udon.

All specimens except for Pimai 331/D/3 are to be classified as bronze. This holds true also for the metal remains from the crucible NP-521. The ring fragment Pimai 331/D/3 is classifiable as copper. The latter is also characterized by the fact that its lead content is so small as to be barely traceable, which corresponds to specimens NP-298/1 and NP-298/2.

TABLE 1
SPECTROANALYSES FROM SITES IN NAM PONG AREA

NO.	SPECIMEN	CU	SN	AG	AS	FE	MN	NI	PB	SB	ZN	BI	CR	AU	CO	TE
1	NP-553/1 bracelet	mc	++	+	tr	tr	—	tr	++	tr	—	+	tr	tr	tr	—
2	NP-553/2 bracelet	mc	++	+	tr	tr	tr	tr	++	tr	—	+	tr	?	tr	—
3	NP-551/1 bracelet	mc	++	+	tr	tr	tr	—	++	tr	—	tr	tr	—	—	—
4	NP-551/2 bracelet	mc	++	+	tr	tr	tr	—	++	tr	—	tr	?	—	—	—
5	NP-551/3 bracelet	mc	++	+	tr	tr	tr	tr	++	tr	—	tr	?	—	—	—
6	NP-551/4 bracelet	mc	++	+	tr	tr	tr	tr	++	tr	—	tr	tr	—	—	—
7	NP-551/5 bracelet	mc	++	+	tr	tr	tr	?	++	tr	—	tr	tr	—	—	—
8	NP-551/6 bracelet	mc	++	+	tr	tr	tr	?	++	tr	—	tr	?	—	—	—
9	NP-549 socketed axe	mc	++	+	++	tr	tr	tr	++	+	—	+	?	—	tr	—
10	NP-521 crucible	mc	++	+	tr	+	tr	—	+	tr	—	tr	tr	—	—	—
11	NP-298/1 bronze fragment	mc	++	+	tr	+	tr	?	tr	tr	—	+	tr	tr	—	tr
12	NP-298/2 bronze fragment	mc	++	+	tr	tr	tr	?	tr	tr	—	+	tr	?	—	?
13	Pimai 331/D/1 small ring	mc	++	+	+	+	tr	tr	++	tr	—	+	tr	tr	tr	—
14	Pimai 331/D/2 small ring	mc	++	+	+	+	tr	tr	++	tr	—	+	—	tr	tr	?
15	Pimai 331/D/3 small ring	++	tr	—	?	+++	tr	+	?	—	—	?	—	—	tr	—

KEY: mc=main component; +, ++, +++=varying quantities of clearly identifiable elements; tr=trace.

Thus, it appears that the high lead content in the raw material of the remaining specimens does not result from the chemical composition of the ore from which the copper was smelted but rather from an intentional addition of lead in the manufacture of bronze. R. Heine-Geldern kindly called my attention to the fact that a high lead content is also characteristic of Dongson bronzes. Except for this intentional lead addition, the pattern of impurities of the copper used in Non Nok Tha and Pimai is apparent. In this context, special attention must be paid to the constant, even if quantitatively varying, presence of bismuth as well as the traces of gold which were found in six instances. The two elements would seem to indicate specifics about the source of the copper ore. It is also important that traces of Te were found in three instances. Since zinc is completely absent and the quantitative contents of antimony, arsenic, and silver are minimal, fahl-ore can be ruled out. The presence of bismuth and gold, on the other hand, indicate copper ore deposits in the vicinity of volcanic formations. On this basis it is possible to pose the question: From where did the inhabitants of Non Nok Tha obtain their copper? Since no field observations concerning prehistoric copper mining are available, it is necessary to rely on the relevant literature. The reports by J. Charaljavanaphet may provide a solution to the problem. He writes: "Copper minerals occur in many localities of Thailand, but no commercially valuable copper deposits have yet been found. Among the copper minerals which have been recognized are chalcopryrite, chalcolite, azurite, malachite, cuprite, and native copper" (Charaljavanaphet 1951). It can hardly be assumed, however, that the inhabitants of Non Nok Tha would have met their needs for copper through import from a very distant area. Therefore, special attention has to be paid to the ore deposits around Phetchabun, although the distance to the sites of Non Nok Tha is still 80 to 100 km.

Charaljavanaphet reports on copper ore deposits around Phetchabun:

Copper prospects in Changrat Petchabun [*sic*] occur along the Huai Phi, about 9 kilometers south of the city of Petchabun, and in the Pa Daeng area about 6 kilometers east of the city. At the Huai Phi prospect copper minerals occur in a thin lenticular quartz vein about 3 to 5 centimeters wide, lying along the contact between andesite porphyry and a sandstone-slate series. The vein strikes about north and can be traced for several meters. Chalcolite is the principal copper mineral but malachite, azurite, and cuprite are also present. A little prospecting was done at the locality in 1934 but the results were discouraging.

At Pa Daeng copper minerals occur in quartz lenses in andesite porphyry, and at Boh Khok Na Kea, in the same area, malachite and azurite fill crevices in quartzite. Copper minerals in narrow quartz veins at Boh Noen Thong have an occurrence similar to those at Huai Phi. At Boh Khao Thong, about 2 kilometers to the southwest, malachite and azurite appear in a gouge zone.

In connection with the problem of relating the finds to copper ore deposits, the remark that Huai Phi copper ore is in contact with andesite porphyry seems to be of decisive importance, since it would explain the bismuth and gold content. Thus, the source for the copper used at Non Nok Tha may not be definitely identified, but a relation of ore deposit and finished product can certainly be taken into consideration. A verification of this relationship will only be possible, however, through spectro-analyses of ores from the Huai Phi area. It will also be necessary to analyze ores from the Pa Daeng deposition zone in order to be able to positively exclude other possible relationships. Without this supplementary research the origin of the Non Nok Tha copper as indicated above will remain

hypothetical. To express an opinion was possible only on the basis of our many years of experience with spectro-analysis of ore samples.

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