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A thermoluminescence series from Thailand

A series of 26 potsherds from six early sites in Thailand has recently been subjected to thermoluminescence analysis by the Museum of Applied Science Centre for Archaeology at the University of Pennsylvania Museum. Of these 26 sherds, 22 proved to be datable, yielding a sequence of considerable interest. In this note Bennet Bronson, of the Field Museum of Natural History, Chicago, and Mark Han, of the University of Pennsylvania Museum, list and discuss these dates.

The sample from which the sequence derives was comparatively large and well-stratified. Such samples are as yet unusual in the history of archaeological thermoluminescence dating (cf. Aitken, 1968; Ralph and Han, 1969).

Furthermore, the results were reasonably satisfactory, being consistent both mutually and with published radiocarbon dates for the area in question; attempts at using thermoluminescence are not always so successful. And finally, the sequence pertains to a rather new and poorly dated archaeological region where, in spite of the great apparent antiquity of agriculture, metallurgy, and pottery-making (cf. Solheim, 1969), the local chronology depends almost entirely on a handful of radiocarbon dates and tenuous stylistic parallels with other, better-dated parts of the world. The dates presented here increase by more than a quarter the total number of dates of any kind that are available for the prehistory and protohistory of Thailand.

The dates are presented in Table 1. The sherds in the sample come from these sites:

Ban Chiang. A cemetery site in north-east Thailand, excavated in the mid-sixties by Vidhya Intakosai of the National Museum of Thailand and subsequently by various amateur archaeologists. Although unpublished, Ban Chiang has acquired some fame as the source of a red-on-white painted ware that resembles the Yang Shao pottery of China. The site is rumoured to contain copper or bronze artifacts.

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Non Nok Tha. A slightly later cemetery and residential site, also in the north-east, extensively excavated by the University of Hawaii in the late sixties (Solheim, 1968). It has produced evidence for both tin bronze metallurgy and (?dry) rice cultivation at a surprisingly early date—according to the earlier of two radiocarbon sequences, the 3rd millennium bc (Bayard, 1971b).

Ban Kao. A cemetery and residential site in western Central Thailand, of somewhat uncertain date. Said by the excavator (Sorensen and Hatting, 1967) to be Neolithic and to have connexions with the Chinese Lungshanoid complex.

Lopburi Army Camp. A bronze- and perhaps iron-containing cemetery site in Central Thailand, tested by Vidhya in the early sixties.

Chansen. A moated town site just north of Lopburi, excavated jointly by the University Museum and the National Museum of Thailand in the late sixties (Bronson, n.d.). The upper levels of the site contain a protohistoric and early historic sequence that extends from Phase II (dated by C14 to AD 0-250) to Phase VI (dated indirectly to about AD 800-1000). The lowest strata represent a Metal Age occupation, designated Phase I, with bronze and iron implements and inhumation burials.

Ban Dai. A cemetery site currently being excavated by Vidhya some 50 km. north-west of Chansen. The graves produce both bronze and iron.

<i>Site</i>	<i>Sample No.</i>	<i>Provenience</i>	<i>Date</i>
Ban Chiang	104	Surface?	BC 4630 ± 520
	271	70-80 cm. level	BC 3570 ± 480
	273	130 cm level	BC 3590 ± 275
Non Nok Tha	276	Burial 90, Level III	BC 2420 ± 200
	277	Burial 14, Level ?	BC 2995 ± 320
	278	Burial 73, Level IV	BC 2535 ± 200
	279	Burial 73, Level IV	BC 2350 ± 150
Ban Kao	102	Excavated? Surface?	BC 290 ± 255
Lopburi	103	Burial. Nr not known	BC 700 ± 166
	259	Burial. Nr not known	BC 1224 ± 300
Chansen I	280	Trench Eb, Lot 9	BC 1340 ± 200
	281	Trench P, Lto 8	BC 650 ± 200
Ban Dai	261	0-30 cm. below surface	AD 173 ± 150
	262	0-30 cm. below surface	AD 714 ± 120
	263	0-30 cm. below surface	AD 1 ± 100
	264	0-30 cm. below surface	AD 1166 ± 100
	274	Surface find	AD 395 ± 150
	275	Surface find	AD 35 ± 110
Chansen VI	283	Trench Dg, Lot 2	AD 300 ± 120
	284	Trench Ka, Lot 1	AD 1210 ± 100
	285	Trench M, Lot 2	AD 1340 ± 100

Table 1. Thermoluminescence dates

The estimates for Ban Chiang fit well with the hypothesis, arrived at through typological analysis (Solheim, pers. comm.), that the site is contemporary with or earlier than the lowest strata at Non Nok Tha. A 4th- or even 5th-millennium date is also not inconsistent with the Yang Shao parallels mentioned above. The fact that copper or bronze may be present

at Ban Chiang increases the interest of this early dating.

Along with the evidence for rice cultivation and the smelting and casting of tin bronze, the soils of Non Nok Tha have produced no fewer than 26 radiocarbon dates. These fall into two conflicting sequences, one indicating a span of occupation that covers the 3rd and 2nd millennia

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bc, and the other indicating that the occupation began and ended about a thousand years later. Bayard's (1971a) suggestion that the latter sequence may represent contamination from a modern source is supported by the thermoluminescence results.

The single Ban Kao date is probably not to be trusted—not only is the provenience of the tested sample uncertain (it may be a surface find) but there are solid grounds for believing that Ban Kao is earlier than the 3rd century BC. Although copper or bronze artifacts are known to occur in at least some burials at related Kanchanaburi 'Neolithic' sites (Sood Sangvichien, pers. comm.), Ban Kao probably contains no iron. Thus, considering that iron seems on present evidence to have become generally diffused throughout Central Thailand at about 1000 BC (the point is discussed below), it would be unwarranted to push this complex down further than the terminal 2nd millennium.

Chansen I, the Lopburi Army Camp, and Ban Dai all belong to a group of sites (the others include the lower levels of Phimai, Huai Duk near Phitsanulok, and perhaps Phong Tuk) which can be called Late Metal Age—that is, they contain (1) iron as well as bronze artifacts, and (2) inhumation burials, showing that they antedate the diffusion of those Indian-derived cultural traits (including cremation) which mark the beginning of the protohistoric period in the area. The exact dating of these sites is problematical. Considering that Indian influences reached Chansen at about the time of Christ (Bronson, n.d.) and that none of the sites is geographically isolated or, indeed, more than a few-score kilometres distant, it seems to follow that all of them have a BC date. The year AD 1, however, is only a late limit; at some sites, the late Metal Age occupations must have begun and ended long before then.

The main reason for thinking so is that iron-containing cemetery sites are so numerous (in view of the very small amount of exploration that has been done) and so different from each other—different enough in terms of the artifacts they contain for one to postulate that they stretch out over several millennia. Since Non Nok Tha contains no iron and lasts until at least 2000 BC,

a several-thousand-year time-span for the Late Metal Age is clearly excessive; moreover, there are other pure bronze sites—Kok Charoen (Watson, 1968) and possibly Ban Kao—which must be squeezed into the interval between terminal Non Nok Tha and the introduction of iron. It seems that the best solution is to accept the Chansen I and Lopburi thermoluminescence dates at face value and to place the beginning of the late Metal Age in the very late 2nd millennium BC. This would mean assuming that two sites, geographically close and culturally quite distinct, are contemporary with each other, but such an assumption makes sense. Any interpretation must take account of the apparent fact that Central Thailand during the late prehistoric period was a region of extraordinary cultural diversity.

The Ban Dai dates are less convincing than those of the other two iron inhumation sites. Three of the six determinations (AD 395, 714, and 1166) are improbably late. While it is vaguely possible that the practice of inhumation may have lingered on at Ban Dai for one or two centuries after the beginning of the Christian era, AD 300 is the outside limit. The ceramics of the later part of the protohistoric period (between AD 300 and 600) have a very wide distribution in the neighbourhood of Ban Dai (they are found for instance, at Chansen, U Thong, Huai Duk, Muang Bon, and U Ta Phao-Chainat) and are easily recognized. They do not at all resemble the vessels found in the graves at Ban Dai. The three earlier dates (AD 1, 35, and 173) may be all right but should be accepted only with the reservation that their stratigraphic provenience is none too good. The samples in question came from the fill of very shallow graves with bottoms less than 30 cm. below the surface; moreover, none of them belonged to vessels which could be definitely identified as part of the actual grave furniture. There is thus a clear chance that all the samples are intrusive. The presence of a large earthwork-surrounded early historic period (AD 600–1000) town site about 1 km. distant suggests that a good deal of activity took place at the cemetery area long after the graves were dug.

The Chansen VI datings are also too late,

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though not so far off as those of Ban Dai. Various lines of reasoning that will not be gone into here (Bronson, n.d.) make it seem that the sixth phase at Chansen cannot have lasted much beyond AD 1100 and cannot have begun earlier than AD 800. Sample 283 was a rather nondescript sherd, and its early dating can perhaps be explained by assuming it was redeposited from a lower stratum. But samples 284 and 285 were both from highly characteristic Phase VI vessels making their 13th- and 14th-century datings difficult to explain. Either the above-mentioned lines of reasoning are quite wrong or there is an error-producing factor involved (later re-heating?) which the analytic methods cannot yet control.

Neither the Chansen VI nor the Ban Dai results, however, are wildly unreasonable. Only the Ban Kao date is so far from what one expects it to be as to cast doubt on the credibility of the thermoluminescence technique itself. In general, and especially with regard to those samples which are from deep, well-stratified sites (Non Nok Tha and Chansen) and from highly distinctive vessels (Ban Chiang), the dates shown in Table 1 are consistent and believable. They are at least as confidence-inspiring as most comparable series of radiocarbon dates.

The fact that thermoluminescence dating seems to work here has two important consequences. First, it increases the likelihood that the technique can be trusted in other cases as well, that it will produce a passably accurate chronology even in parts of the world like South East Asia where corroborative radiocarbon and historical datings are nonexistent. Judging by this one set of results, thermoluminescence in archaeology has begun to come of age and need no longer be considered an experimental method suited mainly to the authentication of museum artifacts. When and if laboratory facilities and technicians become available, excavators should be able to use it as a standard dating tool.

Second, one is encouraged to accept these particular dates with only a normal amount of caution. The thermoluminescence determinations for Non Nok Tha and Ban Chiang fit so well with the radiocarbon datings that one

feels some confidence in the hitherto controversial assertions about the 3rd or 4th millennium origins of South East Asian rice and bronze-using. And the late 2nd millennium dates for Chansen I and the Lopburi Army site, although far from solidly established, must be taken seriously. They are the first evidence obtained, by any method, that bears on the problem of when the use of iron arrived or was discovered in South East Asia. That this seems to have happened so early, a half-millennium before iron is generally supposed to have appeared in China and India, is surprising but not incredible. It is merely one more element in the pattern of remarkable precocity that is currently emerging as the leading theme of South East Asian prehistory.

Postscript. Since the writing of this article, it has come to the authors' attention that five other T-L dates exist (see Zimmerman and Huxtable 1969, 106) which are relevant to the Central Thailand sequence. Three are from Tha Muang at U Thong, a protohistoric and early historic site in western Central Thailand; they cluster neatly in the time range ad 800-1100. Two are from Kok Charoen in the north central part of the country; the dates are given as 170 bc and 980 bc. Since Tha Muang is stylistically connected with the later phases at Chansen (i.e., Chansen III-VI) and since Kok Charoen, as already stated, appears to be a late Early Metal Age site, neither of these groups of determinations conflicts seriously with the dates presented above.

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