RADIOCARBON DATING OF THE DONG DAU PERIOD

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ABSTRACT

This paper focuses on the dating of the Dong Dau culture, one of the late prehistoric Bronze Age cultures in the Red River delta of Vietnam. Using statistical methods, the author has obtained a date range for the Dong Dau culture which places it 200 years earlier than previously considered.

INTRODUCTION

Dong Dau sites are important not only for understanding the sequence of prehistoric cultures in the Song Hong (Red River) region, but also for the insight they provide into the development of early civilizations in Vietnam. The relative chronology of the prehistoric cultures of the Red River is already well established. The Dong Dau culture is preceded by the Phung Nguyen, and succeeded by the Go Mun and Dong Son cultures. However, the precise dating of these prehistoric cultures is uncertain because of deficiencies in the number of archaeological samples dated by scientific methods, particularly radiocarbon. Furthermore, some of the older radiocarbon dates from overseas laboratories need to be refined.

THE DISTRIBUTION OF DONG DAU SITES

To date, 17 archaeological sites belonging to the Dong Dau culture have been identified. All of the sites are located in the Red River Valley in the Bac Bo region. Figure 1 shows the distribution of these Dong Dau sites in the provinces of Vinh Phuc, Phu Tho, Bac Ninh, Bac Giang and Ha Tay, as well as in the city of Ha Noi. Most sites are located in low-lying areas next to rivers, terraces or small hills in the centre of Bac Bo.

The type site, Dong Dau A, as well as Dinh Xa and Thanh Den, are located in Vinh Phuc Province. The sites of Go Dien (burial), Dong Den (upper layer), Noi Cam (lower layer) and Dong Dau B are located in Phu Tho Province. Go Vuon Chuoi, Dong Den (upper layer), Mao Son and Doi Da (lower layer) are located in Ha Tay Province. The sites of Bai Men (middle layer), Dinh Trang (layer 3), Tien Hoi and Xuan Kieu are located in Ha Noi City. The sites of Dinh To and Tu Son (upper layer) are located in Bac Ninh Province. Dong Lam (lower layer) is located in Bac Giang Province.

THE RADIOCARBON DATES

To date, 26 Dong Dau archaeological samples have been dated by the radiocarbon method. We have 17 dates for Thanh Den, 7 dates for Dong Dau A, one date for Dinh To and one for Vuon Chuoi. These dates are given in Table 1 (data from Ha Van Tan 1999; Pham and Nguyen 2001; Ngo and Nguyen 2002)

DISCUSSION

As can be seen from Table 1, the 26 samples radiocarbon dated come from four of the sites belonging to the Dong Dau period. If the date of 3730 BP is rejected (Laboratory code Bln-3262) as an outlier, the remaining 25 can be shown in the frequency distribution graph below (Fig. 2).

The average age ($\bar{A}$) and standard deviation σ (A) for these 25 sets of data can be calculated as 3040 years BP ± 250 years, using the equation $\sigma(A) = [\Sigma(A_i - \bar{A})^2/(25-1)]^{1/2}$ to calculate the standard deviation. The absolute age frame for the Dong Dau cultural period is determined by estimating the confidence interval. If the individual C14 values are plotted in chronological intervals on the bottom axis, and the frequency of occurrence of each value in the chronological intervals is plotted on the left-hand axis, there would be a distribution similar to the one shown in Figure 2. The familiar bell-shaped curve that is superimposed on the actual ages represents what is known as a normal of Gaussian distribution. The confidence interval of the Dong Dau cultural period by C14 dating can then be estimated by the equation $| A - \bar{A} | \leq \varepsilon$, where $\bar{A}$ is the average of the C14 dates and ε is the estimated value of accuracy.

Therefore, the confidence interval of the Dong Dau cultural period by radiocarbon dating will be determined from the experimental error and 'Student criteria' as $| A - \bar{A} | \leq t(P;k) \times s / N^{1/2}$, where P is the probability that any C14 age will be located within the confidence interval (95%, 99% or 99.9%), k is the degree of freedom calculated as k= N-1, N is the number of C14 dates (N=25), and s is the experimental root-mean-square deviation of the individual C14 ages, which is given by the formula: $s = [\Sigma(A_i - \bar{A})^2/(N-1)]^{1/2} = (1487895/24)^{1/2} \approx 250$.

Thus, if we select a confidence interval of 99.9% and derive the value of t from a table of Student distribution, this being 3.745 (Ruminski 1972, Ryan 1989), the date range of the Dong Dau cultural period will be given by
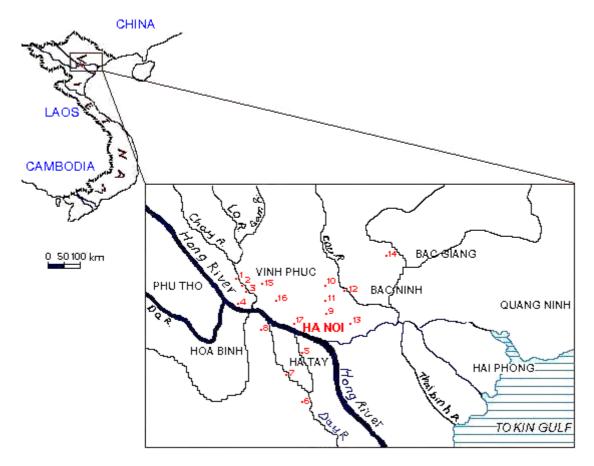
Figure 1. The distribution of Dong Dau sites.

1	Go Dien	4	Dong Dau B	7	Mao Son	10	Dinh Trang	13	Tu Son	16	Dinh Xa
2	Ma Lao	5	Go Vuon Chuoi	8	Doi Da	11	Tien Hoi	14	Dong Lam	17	Thanh Den
3	Noi Gan	6	Dong Den	9	Bai Men	12	Xuan Kieu	15	Dong Dau A		

the formula $|\,A - \bar{A}\,| \leq 3.745 \times 250/5 \approx 200$, or $\bar{A} - 200 \leq A \leq \bar{A} + 200$.

This means that the chronological interval of the Dong Dau cultural period by C14 dating extends from 3250 to 2850 BP within 99.9% confidence. On the other hand, the statistical analysis also shows that, according to the '3 sigma' criterion, we can reject the date of 3730 BP (Bln. 3262). This date can be explained as possibly belonging to an earlier cultural period, or due to mistakes in the dating procedure (sampling, treating, measuring, reporting).

It is worth noting that the dates used in this calculation have not been dendrocorrected or subjected to the new C14 half-life. If corrected, the Dong Dau time span will become earlier, at 3600 to 3050 years BP. This dating seems to be in accordance with the dates proposed by Ha Van Tan (1999).

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Table 1. Radiocarbon dates for the Dong Dau culture.

No.	Site	Sample Code	Lab. Code	Depth (cm)	Age BP
1		83.TD (6)	R-9755/1	113	2500 ± 90
2		83.TD (15)	R-9755/2	149	3230 ± 70
3		83.TD (18)	R-9755/3	230	3390 ± 70
4		83.TD (4)	Bln-2981	113	2860 ± 70
5	Thanh Den	83.TD (4)	Bln-2953	115	2920 ± 70
6		83.TD (7)	Bln-2954	138	2960 ± 60
7		83.TD (9)	Bln-2955	139	2940 ± 60
8		83.TD (16)	Bln-2956	149	3350 ± 50
9		83.TD (17)	Bln-2957	162	3000 ± 60
10		84.TD (7)	Bln-3261	115	3090 ± 60
11		84.TD (12)	Bln-3262	146	3730 ± 50
12		84.TD (6)	Bln-3263	114	2630 ± 50
13		83.TD (8)	Bln-3264	124	3650 ± 70
14	_____	84.TD hole b (5)	HCMV07/93	115	3100 ± 65
15		87 DD (1)	Bln-3811	115	2830 ± 80
16		87 DD (2)	Bln-3810	186	2960 ± 150
17		87 DD (4)	Bln-3711	340	3050 ± 80
18	Dong Dau A	87 DD (17)	Bln-3714	115	2830 ± 80
19		87 DD (2)	HCMV05/93	340-360	3015 ± 50
20		87 DD (Ha)	HCMV06/93	340-360	3100 ± 50
21		DD 99.H1.L15.e6	HNK-31	440	2950 ± 100
22		DD 99.H1.L6.b8	HNK-29	160	2955 ± 110
23	_____	DD 99.H1.L15.e8	HNK-32	340	3500 ± 110
24	Dinh To	DD 99.H1.L1.a3	HNK-33	40	2980 ± 130
25	Go Vuon Chuoi	99DTAL1:1	ANU-11117	50-70	3060 ± 60
26		GVC.H1 (1969)	Bln984	80	3070 ± 100

Codes: ANU- Australian National University (Australia); Bln – Berlin Radiocarbon Laboratory (GDR); HCMV- Laboratory Isotopes Hydrology (Vietnam); R- Auckland Laboratory (New Zealand); HNK- Hanoi Radiocarbon Laboratory (Vietnam). The above radiocarbon dates are calculated with a half-life of radiocarbon T12 = 5568 years (originally determined by Libby), and are uncalibrated.
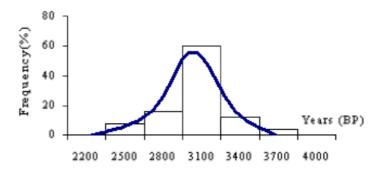

Figure 2. Frequency distribution of uncalibrated radiocarbon dates for the Dong Dau period