

## BERLIN RADIOCARBON DATES V

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The dates presented in this paper comprise results of determinations made on archaeologic and geologic material from Socialist Republic Vietnam since 1969. Radioactivity was measured twice for 48 hours with gas proportional counters of Houtermans-Oeschger type, using methane at 1000mm Hg pressure as filling gas. Influence of cosmic and local environmental radiation on the counters was reduced with 30 tons of shielding material as described earlier (R, 1970, v 12, p 400-420).

Chemical pretreatment was done by leaching the samples with 5% ammonium hydroxide solution in a Soxhlet-extractor. Humic acid, dissolved by the ammonium hydroxide is prepared from this solution by evaporating the solvent. If enough humic acid is available, both fractions are dated. After full or partial removal of humic acid, samples were leached with 5% hydrochloric acid. The first step in methane gas production is combustion of samples in an oxygen stream (De Vries, 1953). The carbon dioxide generated was purified by precipitating calcium carbonate. The dried calcium carbonate was placed into a bulb connected to a vacuum line and evacuated and heated to 100°C for 30 minutes. Radon was removed totally by this procedure. Purified carbon dioxide was generated by adding phosphorus acid. Methane was formed by reacting a measured amount of carbon dioxide with stoichiometric plus 10% this amount of hydrogen. Ruthenium catalyst heated to about 500°C was used for complete conversion. The purity was checked by an infrared analyzer. From shells and snails carbon dioxide was evolved with diluted hydrochloric acid.

Age calculations are based on the Libby half-life of  $^{14}\text{C}$ ,  $5570 \pm 30$  years and the modern activity given by 95% of the activity of oxalic acid standard as well as oak-tree rings grown between 1850 and 1860 near Greifswald, GDR. Errors quoted are the standard deviation obtained from the number of counts only. For shell samples, dates are computed without any correction for environmental and isotopic fractionation. No hardwater effect has been taken in account because it depends on the type of water in which shells and snails lived. Ocean surface water has a unique average  $^{14}\text{C}$  recent-concentration of 95 to 97%, therefore marine shells and snails may be dated about 400 years too old. The  $^{14}\text{C}$ -content of fresh water differs between 50 and 100% of atmospheric  $^{14}\text{C}$ -content, depending on concentration of dissolved limestone in water. An average 85% of modern atmospheric  $^{14}\text{C}$  concentration has been measured for recent lakes, therefore freshwater snails may be dated about 1000 years too old.

Shells excavated in limestone caves were cleaned by leaching with tartaric acid. To investigate a possible exchange of inorganic carbon,

shell material was dissolved in two fractions by 10% hydrochloric acid. The two fractions, the outer part of shell denoted by No. I and the inner part denoted by II, were dated separately. If dates of fractions I and II agree well, the possibility of carbon exchange seems to be low. Large discrepancies between fractions I and II indicate possible carbon exchange.

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#### I. ARCHAEOLOGIC SAMPLES

The dates published are part of long standing research program, covering the chronology of prehistoric and early historic cultures. Cooperation with the Institute of Archaeology, Hanoi, made possible, for the first time, dates for Paleolithic to Medieval periods in N regions of Vietnam.

Subtropical climate is not conducive to preservation of fossil organic matter. Only shells of snails and mussels could be dated from limestone caves. Dates on freshwater shells are possibly too old, because of limestone drainage where shells were formed. For this reason we have been cautious in interpreting the chronology. Some of our results have been cross-checked at the Radiocarbon Laboratory, Chinese Academy of Sciences, Peking.

In general, most dates are correlated with stratigraphy and cultural sequence. They confirm continuity from Late Paleolithic Son Vi culture to Mesolithic or Proto-Neolithic Hoa Binh culture. Some unexpectedly old dates have been obtained from recently excavated sites with pre-Hoabinhian stone industry in NW Vietnam (Ha Van Tan, 1976b). The first evidence for "Neolithic technology" like grinding stones and axes with polished cutting edges about 10,000 BP comes from Bo Lum cave in the Bac Son massif. Little can be said about the beginning of ceramic tradition in Vietnam. Cultural layers with potsherds in mountainous areas are scarcely dated and in upper levels of coastal sites impressed or cord-marked pottery falls within the 5th millennium BC.

Similarly circumstances exist for the first use of copper or bronze. The crucial problem is the age and nature of the Phung Nguyen culture as transition from Late Neolithic to Early Bronze. A single date from Ma Dong, prov Ha Thay, and another from Hang Gon in Southern Vietnam (Saurin, 1968) point to a distribution of metal-working ca 2000 BC. The Final Bronze and Early Iron periods are dated from settlements and cemeteries of the Dong Son culture between 6th and 2nd centuries BC. The Sa Huynh culture existed at the same time in S parts of Vietnam which confirm radiocarbon dates from urnfield graves in prov Long Khanh (Delibrias *et al*, 1974) and from Hang Gon-site near Xuan Loc (Thommeret & Thommeret, 1966).

Measurements in the following list ranged in groups corresponding to chronology of sites. Dates are expressed as before AD 1950. Archaeologic data are quoted from Vietnamese publications (Le Xuan Diem; Hoang Xuan Chinh, 1977) and information was provided by the excavators and their sponsoring institutions. Owing to typographical difficulties, diacritical marks are omitted from Vietnamese words.

*A. Paleolithic and Hoabinhian*

**Bln-1408. Tham Khuong, T K 74 28,130 ± 2000**

Shells of land snails (*Cyclophorus siamensis* Sowerby) from rock shelter near Chieng Sinh, dist Tuan Giao, prov Lai Chau (21° 35' N, 103° 19' E). Site near spring of Ma R with occupation deposit 2m thick. Lithic material contained massive pebble chopping tools, pointed picks of Hoa Binh type, and other culturally indeterminate stone implements; polished tools and pottery only in uppermost horizon. Snails from 1.5m below surface coll Feb 1974 by Chu Van Tan (1976), Archaeol Inst Hanoi.

**Bln-1412. 33,150 ± 2300**

Same sample as Bln-1408 in separate preparation. *Comment*: dates are inconsistent and older than expected for Hoa Binh culture. Future studies should clear up possibility of Paleolithic occupation.

**Bln-1735 I. Phung Quyen, P Q 76 18,390 ± 125**

**Bln-1735 II. (2nd fraction) 18,180 ± 125**

Shells of land snails (*Cyclophorus siamensis* Sowerby) from rock shelter near Mai Hich, dist Mai Chau, prov Ha Son Binh (20° 34' N, 105° 2' E). Occupation deposit was 0.50m thick from end of Pleistocene to Hoa Bin culture. Sample in basal layer coll Oct 1976 by Nguyen Van Binh, Archaeol Inst Hanoi.

**Bln-1855 I. 17,470 ± 125**

**Bln-1855 II. (2nd fraction) 18,300 ± 125**

Shells from same sample as Bln-1735 in a separate preparation. *Comment*: relatively consistent dates point to occupation in Paleolithic time.

**Bln-1844 I. Nui-I, N 76 13,080 ± 115**

**Bln-1844 II. (2nd fraction) 14,665 ± 150**

Shells of land snails (mostly *Cyclophorus siamensis* Sowerby) from cave site near Cam Giang, dist Cam Thuy, prov Thanh Hoa (20° 15' N, 105° 30' E). Limestone cave in mts downstream Ma R settled from end of Pleistocene to Hoa Binh period. Sample coll Oct 1976 in basal layer of Trench 4 by Hoang Xuan Chinh and Vu The Long, Archaeol Inst Hanoi.

**Bln-1713 I. Con Moong, C M 76 11,755 ± 75**

**Bln-1713 II. (2nd fraction) 11,840 ± 75**

Shells of land and freshwater snails (*Cyclophorus siamensis* Sowerby, *Antimelania siamensis*, *Lanceolaria* sp) from cave site in Cu Phuong Nat Park, Thanh Yen, dist Thach Thanh, prov Thanh Hoa (20° 18' N, 105° 54' E). Cave Con Moong ("Beast-Cave") in limestone cliff 40m high, excavated 1975/76 by Nguyen Khac Su and Hoang Xuan Chinh (Pham Huy Thong, 1977). Occupation deposit, 3.50m thick, indicated 9 layers of cultural development from final Paleolithic (Level I) to early Hoa Binh (Level II) and late Hoa Binh, respectively, Bac Son period (Level III). Sample, from Level I, 3 to 3.20m deep, Layer 9, assoc with pre-Hoabinhian artifacts, related to Late Paleolithic Son Vi culture. Coll April 1976 by Vu The Long. *Comment*: dates agree with archaeol expectations. Cross-check of shells from same Layer 9 dated at Peking, ZK-379: 11,090 ± 185 BP. Additional soil sample mixed with ashes from Hoa Binh Level II (2 to 2.40m below surface) contained insufficient carbon for <sup>14</sup>C dating, but it was dated stratigraphically at Peking, ZK-380: 9905 ± 150 BP.

**Bln-1351. Hang Pong-I, H P-I 73 11,330 ± 180**

Shells of land and freshwater snails (mostly *Cyclophorus siamensis* Sowerby) from cave site near Muong The, dist Moc Chau, prov Son La (21° 02' N, 104° 45' E). Cave I in mts bounding Black R valley yielded only 0.30m thick occupation deposit dated to early pre-Hoabinhian phase. Besides characteristic Hoa Binh tools, artifacts related to Late Paleolithic Son Vi culture were also present. Sample from Trench I, 0.25m depth, coll 1973 by Nguyen Xuan Dieu and Do Dinh Truat (1974), Archaeol Inst Hanoi.

**Bln-1352. 11,915 ± 120**

Same as Bln-1351 in separate preparation. *Comment*: late Pleistocene age of Hang Pong site was expected on strength of some faunal remains.

**Bln-1541 I. Sung Sam, S S 75 11,365 ± 80****Bln-1541 II. (2nd fraction) 10,770 ± 75**

Shells of land and freshwater snails (mostly *Cyclophorus siamensis* Sowerby) from cave site near Huong Son, dist My Duc, prov Ha Tay (20° 50' N, 105° 35' E). Cave in mts ca 50km E of Hanoi, settled during Hoa Binh and later periods. Sample from Trench A, depth 1.20 to 1.40m below surface. Coll March 1975 by Ha Van Tan and Tran Quoc Vuong, Archaeol Dept, Univ Hanoi.

**Bln-1275 I. Tham Hoi, T H 72 10,875 ± 175****Bln-1275 II. (2nd fraction) 10,125 ± 175**

Shells of freshwater snails (mostly *Brotia variabilis* Benson) from cave site near village Bong Khe, dist Con Cuong, prov Nghe An (19° 03' N, 104° 50' E). Limestone cave in mts along Ca R, excavated 1972 by Nguyen Xuan Dieu and Chu Van Tan, Archaeol Inst Hanoi. Occupation

deposit 1.6m thick, yielded numerous artifacts typologically dated to early Hoa Binh culture; trimmed axes and pottery missing. Sample coll from layer of Trench III, 0.6m deep (Hoang Xuan Chinh, Nguyen Xuan Dieu & Chu Van Tan, 1974).

**Bln-1276 I.** **10,255 ± 150**

**Bln-1276 II. (2nd fraction)** **10,815 ± 150**

Same sample as Bln-1275 in separate preparation. *Comment*: slightly older dates than Hang Chua (Bln-1274, -1304) that agree with archaeol expectations.

**Bln-1273 I. Mieng Ho, M H 72** **3800 ± 70**

**Bln-1273 II. (2nd fraction)** **4170 ± 60**

Shells of freshwater snails (*Vivi parvus* sp, *Brotia variabilis* Benson) from cave site near village 'Than Sa, dist Vo Nhai, prov Bac Thai (21° 48' N, 105° 53' E). Cave in mts from upper Cau R, excavated 1972 by Chu Van Tan and Hoang Xuan Chinh, Archaeol Inst Hanoi. Occupation deposit, 0.5m thick, yielded only massive choppers, scrapers, and many small, flaked artifacts (80%) that resembled Paleolithic types; polished tools and pottery missing. Lithic material, different from other North Vietnamese caves dated either to Mesolithic or Paleolithic period (Truong Hoang Chau, 1974). Sample coll from upper level of Trench III, 0.1m below cave surface. *Comment*: date younger than expected; perhaps cave reinhabited in late Neolithic time or shell sample was mixed with recent gastropods.

**Bln-1274 I. Hang Chua, H C 72** **9075 ± 120**

**Bln-1274 II. (2nd fraction)** **9325 ± 120**

Shells of freshwater and land snails (*Angulyagra* sp, *Brotia variabilis* Benson, *Cyclophorus siamensis* Sowerby) from cave site near village Ky Son, dist Tan Ky, prov Nghe An (19° 06' N, 105° 20' E). Cave in Nui Roi Mts at left bank of Ca R yielded occupation deposit, 2m thick, with stone industry of classic Hoabinhian. In addition to sumatraliths, appear chipped, flat artifacts, resembling prototypes of Bac Son axes; but tools with polished cutting edges and pottery were not found. Sample excavated 1972 in Trench A, at 1.5m depth, by Vo Quy and Nguyen Van Hoa, Archaeol Inst Hanoi (Vo Quy, 1973).

**Bln-1304.** **9175 ± 120**

Same sample as Bln-1274 in separate preparation.

**Bln-913 I. Hang Dang, H D 69** **7665 ± 65**

**Bln-913 II. (2nd fraction)** **7580 ± 80**

Shells of land snails (*Cyclophorus siamensis* Sowerby) from cave site in Nat Park Cuc Phuong, dist Nho Quan, prov Ninh Binh (20° 18' N, 105° 55' E). Cave with 2.05m thick occupation deposit and 3 burials

excavated 1966 by Hoang Xuan Chinh and Chu van Tan. Uppermost level of late Neolithic period (to 0.4m depth) yielded a shouldered axe and some crude potsherds. Sample coll 1969 in layer of Trench 2, 0.6m deep, assoc with tools with polished edges, grinders, and pestles of late Hoa Binh types. *Comment*: date fits well with estimated age; an older date is expected for beginning of site occupation because of distinguishing technologic traits in lower horizons.

*B. Bacsonian and Coastal Neolithic*

**Bln-1001 I. Bo Lum, B L 70** **9990 ± 200**

**Bln-1001 II. (2nd fraction)** **10,295 ± 200**

Shells of land and freshwater snails (mostly *Brotia variabilis* Benson) from cave near Xuan Mai, dist Van Quan, prov Lang Son (21° 50' N, 106° 30' E). Site Bo Lum in limestone massif Bac Son is identical with cave Con Khe, excavated by M Colani (Mansuy, 1925). Occupation deposit dated to Bac Son culture, represented by axes with polished cutting edges and stone implements with "marques basconiennes". Sample coll 1970 from middle horizon of occupation layer, 0.6m thick, by Hoang Xuan Chinh. *Comment*: date is satisfactory although slightly early. On the other hand, chopping tools and lack of pottery indicate an older stage of Bacsonian.

**Bln-915 I. Bo Nam, B N 70** **7960 ± 60**

**Bln-915 II. (2nd fraction)** **7875 ± 60**

Shells of land and freshwater snails (*Cyclophorus siamensis* Sowerby, *Vivi parus* sp, *Brotia variabilis* Benson) from cave near village Keo Phay, dist Bang Mac, prov Lang Son (21° 44' N, 106° 29' E). Cave site, better known as Keo Phay, in limestone massif Bac Son, was excavated 1922-1924 by H Mansuy (1925). Complex dated to early Bac Son culture with partial polished axes, but no pottery. Sample coll 1970 in horizon, 0.2m deep, of occupation deposit, 1m thick, by Vu The Long, Archaeol Inst Hanoi. *Comment*: date from uppermost level may be consistent with site stratigraphy, but appears late in comparison with Bacsonian stone industry of Bo Lum cave (Bln-1001).

**Bln-1002 I. Tham Hai, T H 70** **9705 ± 80**

**Bln-1002 II. (2nd fraction)** **9645 ± 70**

Shells of land and freshwater snails (mostly *Brotia variabilis* Benson) from rockshelter near village Tan Van, dist Binh Gia, prov Lang Son (21° 54' N, 106° 25' E). Cave in limestone massif Bac Son with faunal remains from Pleistocene and Holocene was partly excavated 1964 by joint expedition of Vietnamese and German Democratic Republic Paleontologists; basal layers were not investigated. Snails from upper level, 0.2m depth, were assoc with artifacts of early Bac Son types. Coll 1970 by Vu The Long.

**Bln-1407. Da But, D B 71 6095 ± 60**

Marine shells (*Corbicula* sp, *Placuna planceta* L.) from open site at left bank of Ma R, dist Vinh Loc, prov Than Hoa (20° 01' N, 105° 43' E). The kitchen midden, 50 × 32m wide, 5m high, is now some 40km from coast, first excavated by E Patte (1932). Cultural assemblage dates to final or post-Bacsonian Neolithic period. Polished axes, grinders, pestles, and cord-marked pottery similar to finds from Quynh Van shell midden in same prov. Sample from Trench A 0.7m below surface. Coll April 1971 by Luu Tran Tieu, Mus Hist Vietnam, Hanoi. *Comment*: date for upper layer of Da But settlement agrees with archaeol expectations and probably indicates <sup>14</sup>C age that is too late for Quynh Van (Bln-914). At time of occupation, sea level was 2 to 3m higher.

**Bln-914 I. Quynh Van, Q V 69 4785 ± 75****Bln-914 II. (2nd fraction) 4730 ± 75**

Marine shells (*Placuna planceta* L., *Arca granosa* L., *Turritella balilum* Kiener) from open air dwelling and burial, in dist Quynh-Luu, prov Nge An (19° 11' N, 105° 40' E). Type site of Neolithic Quynh Van culture is shell midden, ca 7000m<sup>2</sup> wide and 5 to 6m high in plain 5km from coast, excavated 1963-64 (Hoang Xuan Chinh, 1966; Boriskovsky, 1968-70). Cultural assemblage of Quynh Van complex characterized by tools and axes of chipped basalt flakes, heavy grinders and pestles and also by potsherds already found in bottom layer. Sample coll 1969 at 0.50m depth by Hoang Xuan Chinh, Archaeol Inst, Hanoi. In same upper level were 31 graves with skeletons in sitting position. *Comment*: date, compared to Da But (Bln-1407: 6095 ± 60 BP) is younger than expected, perhaps due to dating problems peculiar to marine shells. But small difference between both determinations indicates no isotopic fractionation.

**Bln-1350. Cai Beo, C B 73 ≥40,000**

Charcoal from open settlement Cai Beo on coast of Cat Ba I, prov Hai Phong (20° 40' N, 107° 03' E). The 800m<sup>2</sup> coastal site dating like shell midden Quynh Van and Da But in post-Bacsonian Neolithic period; excavated 1973 by Hoang Xuan Chinh and Nguyen Khac Su, Archaeol Inst, Hanoi. Occupation deposit, 3.2m thick, shows 3 levels in stratigraphic sequence: uppermost (III) with shouldered and stepped adzes belongs to late Neolithic Ha Long culture; intermediate (II) yielded shouldered axes and cord-marked pottery; lower (I) bifacial chipped stone tools and crude sherds from basket-impressed pottery. Sample coll from Trench 1, 2.2m below surface at top of Level I (Hoang Xuan Chinh *et al*, 1974). *Comment*: this anomalously old date remains unexplained; perhaps indicates use of fossil wood washed ashore in prehistoric times. Control date for portion of same sample at Peking (ZK-306: ≥ 40,000) confirmed our supposition.

**Bln-1437. C B 73—Trench 3 3425 ± 60**

Animal bones from Cai Beo site (see above) from Level I, Trench 3, 3 to 3.2m below surface.

**Bln-1486. 3850 ± 60**

Same as sample Bln-1437 in separate preparation. *Comment:* bone dates are inconsistent with each other and with expected age. Because no collagen was isolated, only inorganic fraction of bone was measured. Probably truer age of site occupation indicated by another Peking date (ZK-328.0: 5645 ± 60 BP) for sample from base of Level II.

**Bln-1439 I. Ha Lung, H L 75 6310 ± 60****Bln-1439 II. (2nd fraction) 6485 ± 60**

Shells of freshwater snails (*Brotia variabilis* Benson, *Vivi parus* sp) from cave site near San Duong, dist Hoanh Bo, prov Qang Ninh (21° 04' N, 107° 02' E). Cultural layer assoc with polished stone tools, grinders, and pottery assigned to post-Bacsonian Neolithic period. Sample coll March 1975 in layer, 0.4m deep, by Nguyen Van Hao, Archaeol Inst, Hanoi.

*C. Early and Middle Bronze Age***Bln-1277. Ma Dong, M D 72 4145 ± 60**

Charcoal mixed with soil from prehistoric settlement Ma Dong, near Duong Lam, prov Ha Tay (21° 05' N, 105° 30' E). Excavations reveal occupation in late Neolithic and Bronze age periods. Sample from layer of Trench III, 0.6m deep, dated from transition phase to Early Bronze age. Coll Jan 1972 by Pham Ly Huong, Archaeol Inst Hanoi.

**Bln-891. Trang Kenh, T K 69 3405 ± 100**

Charred wood mixed with loam from prehistoric settlement and burial place near Minh Duc, prov Hai Phong (20° 57' N, 106° 45' E). Large dwelling site, at foot of rocky hills, ca 20km NE of Hai Phong, archaeol dated to transitional period from late Neolithic to early Bronze age. Ceramics with geometric decorations and different types of stone tools indicate assoc with Halong and Phung Nguyen cultures. Excavations since 1968 yielded vegetal remains of beans, pumpkins, gourds, and first firm evidence for rice cultivation (*Oryza sativa*). Sample in Trench I, 1.9 to 2.1m below surface, coll Nov 1969 by Nguyen Thanh Thrai and Trinh Minh Hien, Archaeol Inst Hanoi. *Comment:* charcoal from higher level, 1.4m below surface, of same site was dated in Peking: ZK-307: 3005 ± 90 BP.

**Bln-830. Dong Dau, D D 69 3330 ± 100**

Charred wood from prehistoric settlement Dong Dau, dist Yen Lac, prov Vinh Phu (21° 30' N, 105° 10' E). Excavations since 1965 yields 4 levels of occupation from late Neolithic to Bronze age periods. Stratigraphy indicates Phung Nguyen, Dong Dau, and Go Mun cultures. Sample in basal layer, Trench I, depth 4m below surface, dates to late Phung Nguyen culture. Coll 1969 by Hoang Xuan Chinh, Archaeol Inst Hanoi.

**Bln-1409. Doi Giam, D G 74 2900 ± 60**

Charred wood and organic matter from Bronze age settlement near Quat Thuong, dist Viet Tri, prov Vinh Phu (21° 10' N, 105° 43' E). Occupation layer of partially excavated site, ca 60m<sup>2</sup>, contained decorated pottery and bronze objects dating to Phung Nguyen culture. Sample coll April 1974 in Trench I, 1m below surface, by Ha Van Tan, Archaeol Dept, Univ Hanoi (Ha Van Tan, 1976a). *Comment*: compared to <sup>14</sup>C date of late Phung Nguyen culture from Dong Dau (Bln-830: 3330 ± 100) date is younger than expected.

**Bln-894. Go Vuon Chuoi, G V C 69 3070 ± 100**

Charred wood from prehistoric settlement, Go Vuon Chuoi, near Kim Chung, dist Hoai Duc, prov Ha Tay (21° 3' N, 105° 42' E). Sample from Trench I, 0.8m below surface to Dong Dau culture of Middle Bronze age with archaeol date from 2nd half of 2nd millennium BC. Coll 1969 by Nguyen Duy Ty, Archaeol Inst Hanoi.

**Bln-829. Vinh Quang, V Q 69 3045 ± 120**

Charred wood from Bronze age dwelling and burial site, Vinh Quang, village SW of Hanoi in prov Ha Tay (20° 45' N, 105° 50' E). Assemblage assoc with some wheel-made pottery and bronze tools belonging to late Go Mun culture, commonly dated to end of 2nd and beginning of 1st millennium BC. Sample from Trench I, depth 1.8m below surface, Coll 1969 by Nguyen Duy Ty.

*D. Dong Son culture and Early Iron Age***Bln-1438. Chau Can, C C 74 2325 ± 60**

Wood of dug out canoe-like coffin in Iron age cemetery Chau Can, dist Phu Xuyen, prov Ha Tay (21° 05' N, 105° 30' E). Sample from Burial M 4 with ceramic and other grave goods dated to late phase of Dong Son culture. Coll Sept 1974 by Luu Tran Tieu, Mus Hist Vietnam, Hanoi. *Comment*: date possibly result of greater tree age of coffin is somewhat older than expected.

**Bln-1718. T N 75 995 ± 55**

Wood of agricultural implement (?) found near Chau Can necropolis (see above). Coll 1975 at 1.6m depth by Luu Tran Tieu. *Comment*: wooden object, 1st estimated at Iron age, is from Medieval period.

**Bln-893. Go Chien Vay, G C V 69 2350 ± 100**

Powdered charcoal mixed with loamy soil from settlement near village Kim Hoang, dist Hoai Duc, prov Ha Tay (21° 03' N, 105° 42' E). Occupation layer with decorated potsherds and only a few metal objects of Dong Son culture dated to transition from late Bronze to early Iron age. Sample in Trench I, 0.65m below surface, coll Feb 1969 by Nguyen Duy Ty.

**Bln-1278. Go Mun, G M 72 2385 ± 60**

Charcoal mixed with loamy soil from Bronze age settlement near Thach Vi village, dist Lam Thao, prov Vinh Phu (21° 17' N, 105° 18' E). Excavations since 1963 at type site of Go Mun culture demonstrated occupation from early to late Bronze age. Sample in Trench III, depth 1m below surface, 1st dated to Go Mun culture. Coll Jan 1972 by Nguyen Duy Ty. *Comment:* Bln-1278 is 6 centuries younger than date of Go Mun culture from Vinh Quang (Bln-829: 3045 ± 120 BP). This sample probably assoc with Dong Son culture, which was also present at site (Nguyen Linh and Tran Huong Van, 1969).

**Bln-1733. Lang Ca, L G 76 2235 ± 40**

Charred wood from grave pit in prehistoric cemetery Lang Ca, dist Viet Tri, prov Vinh Phu (21° 18' N, 105° 24' E). Burial with ceramic and bronze objects dated to Dong Son culture. Sample coll Oct 1976 by Nguyen Duy Chiem, Archaeol Inst Hanoi. *Comment:* date agrees with archaeol expectations for age of Dong Son culture.

**Bln-1324. Lang Vac, L V 63 1140 ± 80**

Soil mixed with charcoal detritus from stone-bordered grave pit in cemetery of Dong Son culture in Lang Vac, village Nghia Hoa, dist Nghia Dan, prov Nghe An (19° 20' N, 105° 24' E). Wealthy burials contained, besides pottery, decorated bronze drums, weapons, and tools of late Van Lang epoch; imported from China were some Warring States bronzes dated to 415 to 220 BC (Trinh Minh Hien, 1974). Sample coll April 1973 from Grave 5, 1m deep, by Nguyen Duy Ty. *Comment:* archaeol unacceptable date may be explained by poor quality of sample. Intrusion of organic matter probably caused rejuvenation. A 2nd sample from same cemetery dated by Peking (ZK-310: 1990 ± 85 BP) agrees better with true age (Diep Dinh Hoa, 1976).

**Bln-950. Viet Khe, V K 61 2480 ± 100**

Wood of canoe-like coffin, 4m long, from Viet Khe cemetery, dist Thuy Nguyen, prov Hai Phong (21° 3' N, 106° 42' E). Very rich burials contained > 100 grave goods, including decorated vessels, tools and bronze weapons, wooden oars, spear handles, painted boxes, and also a hide shield with silver application. Cemetery belongs to Dong Son culture of final Bronze or early Iron age. Sample from coffin in alluvial soil, 1.5 to 2m deep. Coll May 1961 by Le Van Lan, Mus Hist Vietnam, Hanoi (Viet Khe, 1965).

**Bln-1227. V K 61-A 2415 ± 100**

Wood from coffin burial in Viet Khe, excavated 1961.

**Bln-1249. 2320 ± 100**

Same sample as Bln-1227.

*General Comment:* primary sample, is somewhat older, perhaps due to greater tree age of big coffin, but all dates agree with archaeol expected age of Dong Son culture.

*E. Medieval Period*

**Bln-1542. An Khe 715 ± 45**

Wood from coffin, found near An Khe, dist Quynh Phu, prov Thai Binh (20° 30' N, 106° 15' E). Grave dated to initial period of dependence of Chinese feudal state; excavated Feb 1975 by Bui Duy Lan, Office Cultural Monuments, Thai Binh.

**Bln-892. Bach Dang, D B 69 1335 ± 100**

Wood of pile from river bank Bach Dang, near Yen Giang, prov Quang Ninh (20° 57' N, 106° 45' E). Pile belongs to palisade several hundred m long, supposedly part of extensive fortification system during battle of Bach Dang, AD 1288. Coll May 1969 in brackish water by Phan Dai Doan and Diep Dinh Hoa (1970), Mus Hist Vietnam, Hanoi.

**Bln-952. B D 69-A 1100 ± 100**

Sample from another pile at same location as Bln-892. *Comment:* though still possible that samples come from inner core of rotted wood, both dates are considerably older than expected. An earlier historic date of battle of Bach Dang, AD 938, was also discussed.

**Bln-949. Hoa Lu, H L 70 1295 ± 100**

Peat with fern (*Acrostichum aureum* L.) from Medieval citadel Hoa Lu, dist Gia Khanh, prov Ninh Binh (20° 15' N, 105° 55' E). Sample from ditch of large earthwork, 2.5m deep, probably dated to 10th century AD to Vietnamese Dinh and Le dynasties. Coll 1970 by Nguyen Manh Loi, Mus Hist Vietnam, Hanoi. *Comment:* sample derives from layer that was periodically flooded. Date inconsistent with archaeol expectations and further studies may demonstrate still older fortification (Pham Van Kinh and Nguyen Minh Chuong, 1970).

II. GEOLOGIC SAMPLES

**Bln-1572. Noi Linh, N L 75 30,160 ± 300**

Wood embedded in lacustrine sediments from Noi Linh, dist Tien Lu, prov Hai Hung. Sample coll 1m below surface by Geol Service, Hanoi.

**Bln-1715. L K-9/5m 7190 ± 80**

Organic matter embedded in alluvial clay from drill-hole L K-9, dist Gia Loc, prov Hai Hung. Sample from 5m below surface and dated ca 6000 BP; coll 1975 by Hoang Ngoc Ky, Geol Service, Hanoi.

**Bln-1716. L K-9/23m ≥40,000**

Sample containing organic matter from same location as Bln-1715, 23m below surface.

**Blm-1717. H P 3336/3****4145 ± 50**

Sediments with organic matter from drill-hole H P 3336, dist Gia Loc, prov Hai Hung. Sample from sands 2m deep dated to Holocene; coll 1976 by Hoang Ngoc Ky.

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