

# RIKEN NATURAL RADIOCARBON MEASUREMENTS IX

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The  $^{14}\text{C}$  dates given below are continued from our previous list (R, 1974, v 16, p 331-357), and results obtained mainly during 1972-73 are described. A 2.7L stainless steel counter and a 3.3L copper counter are used as previously, yielding background counting rates of 3.9 and 5.6cpm, respectively, when filled with dead  $\text{CO}_2$  at ca 1.7atm. Dates have been calculated on the basis of the  $^{14}\text{C}$  half-life of  $5568 \pm 30$  yr and 95% of NBS oxalic acid is modern standard. Errors ( $\pm 1\sigma$ ) include standard deviations for sample counts, background and modern standard, that of half-life, and, also, effective standard deviations for reading of filling pressure and temperature. No correction has been made for any of the samples in this list.

## SAMPLE DESCRIPTIONS

### I. GEOLOGIC AND GEOCHEMICAL SAMPLES

#### *A. Japan*

#### **Kutchan series**

Material from river terrace deposits of Shiribetsu R in Kutchan Basin, Kutchan-cho, Abuta-gun, Hokkaido. Coll 1968 and subm by K Omoto, Tohoku Univ.

+2400  
36,200

—1900

#### **N-927. Kutchan 1**

34,250 BC

Peat developed in upper part of higher terrace sediments ( $42^\circ 55' \text{ N}$ ,  $140^\circ 49' \text{ E}$ ).

340  $\pm$  100

#### **N-928. Kutchan 2**

AD 1610

Driftwood embedded in lowest terrace deposits ( $42^\circ 54' \text{ N}$ ,  $140^\circ 44' \text{ E}$ ). *Comment* (KO): N-927 dates beginning of paleo-Kutchan lake basin by Shiribetsu R; while N-928 dates formation of lowest river terrace on which present Kutchan town is situated (Omoto, 1971). Another date for sample same as N-928,  $500 \pm 85$ ; date for wood from 3rd terrace sediments,  $10,330 \pm 230$  (Nishimura *et al*, 1972).

#### **Tagajo series**

Peat samples from various depths of Tagajo castle site, Ichikawa, Tagajo-cho, Miyagi-gun, Miyagi Pref ( $38^\circ 20' \text{ N}$ ,  $141^\circ 0' \text{ E}$ ). Coll and subm 1971 by Y Yasuda, Hiroshima Univ. Pollen analysis reported by Yasuda (1973).

**N-1154. Tagajo 1** **1830 ± 110**  
**AD 120**

Undecomposed peat from depth 70cm below surface.

**N-1155. Tagajo 2** **2660 ± 115**  
**710 BC**

Slightly decomposed peat from 130cm below surface. *Comment* (YY): dates confirmed conventional deposition rate of 0.9 to 1mm/yr.

**N-1561. Sugoda** **1320 ± 90**  
**AD 630**

Wood from base of peat sediment at river terrace of Shiroishi R, Sugoda, Shiroishi city, Miyagi Pref (37° 53' N, 140° 35' E). Site located near archaeol remains of later Middle Jomon period. Coll by S Niwa, Miyagi Pref Educ Comm; subm 1973 by Y Yasuda.

**N-1004. Toganomitsugi** **1050 ± 110**  
**AD 900**

Carbonized wood fragment on paving stones embedded in black clay layer, underlying silty clay with gravel and farm soil of rice field and underlain by peat layer, ca 1.3m below surface, at Toganomitsugi, Sakawa-cho, Takaoka-gun, Kochi Pref (33° 22' N, 133° 14' E). Assoc with Haji II-type pottery of Kofun period. Estimated age: end of 4th to middle of 5th century AD. Coll 1970 and subm by K Noda, Kochi Pref Educ Center.

**N-1462. Kuroiwaizeki** **>37,800**

Part of timber from dark gray silty layer, 40cm thick, in lowest terrace of Yanase R, ca 2 to 3m above present river bed, Kuroiwaizeki, Sakawa-cho, Takaoka-gun, Kochi Pref (33° 24' N, 133° 14' E). Assoc with cones of *Picea*. Coll 1964 and subm by K Noda.

**N-1565. Eranuma** **1300 ± 90**  
**AD 650**

Peat from top of thick peat sediment at Eranuma, Hewa, Tosa city, Kochi Pref (33° 28' N, 133° 22' E). Pollen analysis shows presence of *Shiia* and *Quercus*. Coll 1973 and subm by K Noda.

**N-1178. Kamichigane** **11,300 ± 170**  
**9350 BC**

Charcoal fragment from depth 7m below surface, left bank of Ekakedani valley, SE of Kamichigane, Kamitakara-mura, Yoshiki-gun, Gifu Pref (36° 15' N, 137° 33' E). Sample was taken from a little stratified pyroclastic flow, 8m thick, containing andesite gravel, underlying loose debris, 5m thick, overlying amphibolic andesite rocks. Mud flow is believed to come from volcano Shirotaniyama. Coll and subm 1971 by K Koike, Komazawa Univ. *Comment* (KK): date should not be much older than 10,000 BP mainly because pottery sherds of Earliest Jomon period were found in upper horizon.

**N-1378. Tashirotai** **11,500 ± 230**  
**9550 BC**

Peat from depth 6 to 6.3m of Tashiro moor, Aomori city, Aomori Pref (40° 42' N, 140° 55' E). Tashiro moor is at +550m and is considered one of oldest bogs in Mt Kita Hakkoda system, with sediments 6 to 7m thick. Pollen analysis shows presence of *Pinus*, *Abies*, *Tsuga*, *Betula*, and *Picea* (Yamanaka, 1965). Coll 1964 and subm by M Yamanaka, Tohoku Univ. *Comment* (MY): according to pollen analysis, date of Late Glacial period (ca 10,000 BP) was expected.

**Otashiroyachi series**

Peat from peat moor, Otashiroyachi, Towada-cho, Kamikita-gun, Aomori Pref (40° 34' N, 140° 52' E). Peat moor is at alt 900m and largest in region of Mt Minami Hakkoda system with sediments 2 to 3m thick. Coll 1967 and subm by M Yamanaka (Nakamura, 1973).

**N-1379. Otashiroyachi 1** **11,800 ± 190**  
**9850 BC**

Peat from depth ca 1.6m. *Betula* pollen prevail (Yamanaka, 1963). Expected age: Late glacial to early postglacial, ca 8000 to 11,000 BP.

**N-1380. Otashiroyachi 2** **1430 ± 85**  
**AD 520**

Peat from depth ca 0.5m. According to pollen analysis, expected age is 4000 to 2000 BP.

**N-1381. Hebizuka** **11,600 ± 150**  
**9650 BC**

Peat from depth 1.2 to 1.5m at Hebizuka, Tamayama-mura, Iwate-gun, Iwate Pref (39° 46' N, 141° 19' E). Peat, ca 0.5m thick, is overlain by ca 0.9m sandy loam and 0.3m farm soil of rice field. Pollens (*Abies*, *Picea*, *Tsuga*, and *Pinus*) show Würm glacial period (Ishizuka *et al*, 1957). Coll 1969 and subm by M Yamanaka.

**Jigokunuma series**

Peat from outcrop at Jigokunuma, Sukayu, Aomori city, Aomori Pref (40° 39' N, 141° 51' E). Peat layer is ca 2m thick and overlain by mud flow sediments probably relating to formation of Mt Kita Hakkoda system. *Abies*, *Picea*, *Pinus*, *Tsuga* and *Betula* pollen prevail. Coll 1971 and subm by M Yamanaka (Miura & Yamanaka, 1975).

**N-1533. Jigokunuma 1** **+1250**  
**26,100**  
**-1100**  
**24,150 BC**

Peat from top of peat layer.

**N-1534. Jigokunuma 2** **+3900**  
**36,000**  
**-2600**  
**34,050 BC**

Peat from bottom of peat layer.

**Bensenuma Coast series**

Samples from peat outcrop at sea cliff of Bensenuma Coast, Kizukuri-cho, Nishitsugaru-gun Aomori Pref (40° 52' N, 140° 17' E). Peat layer, Dekishima bed, overlain by Byobuyama dune, has disconformity, over which are pollens of temperate forest. Coll 1972 and subm by M Yamanaka.

<b>N-1535. Bensenuma Coast 1</b>	<b>5290 ± 115</b> <b>3340 BC</b>
Peat overlying disconformity.	
<b>N-1536. Bensenuma Coast 2</b>	<b>8930 ± 150</b> <b>6980 BC</b>
Peat underlying disconformity.	
<b>N-1537. Bensenuma Coast 3</b>	<b>&gt;37,800</b>
Peat from far below disconformity.	

*B. Australia and New Guinea*

<b>N-1299. Lake Grace</b>	<b>620 ± 75</b> <b>AD 1330</b>
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*Coxiella* shells from shell band in upper unit on lake shore terrace on peninsula projecting S into Lake Grace, 8km W of Lake Grace Township, W Australia (33° 6' S, 118° 24' E). Coll 1971 and subm by J M Bowler, Australian Natl Univ. *Comment* (JMB): dates Holocene high water level of Lake Grace. Relatively low age is consistent with absence of pedogenesis on shell deposit.

**Lake Kurrenkutten series**

*Coxiella* shells impregnated by secondary soil carbonate from pedologic carbonate layer, depth 50 to 70cm, developed on lake shore dune on E margin of L Kurrenkutten near Causeway, W Australia (32° 14' S, 118° 5' E). Coll 1971 and subm by J M Bowler.

<b>N-1300. Kurrenkutten 1</b>	<b>11,900 ± 150</b> <b>9950 BC</b>
Shells weakly cemented by secondary soil carbonate.	
<b>N-1435. Kurrenkutten 2</b>	<b>7770 ± 110</b> <b>5820 BC</b>
Shells heavily impregnated by secondary soil carbonate. <i>Comment</i> (JMB): assuming soil carbonate contents of N-1300 and N-1435 are 10 and 60%, respectively, results suggest <sup>14</sup> C age of ca 5000 to 6000 yr for soil carbonate; age of uncontaminated <i>Coxiella</i> shells is estimated to be at least 15,000 BP.	

**Hines Hill series**

Charcoal in dune sands on E margin of salt lake, 10km S of Hines Hill, Kellerberrin, W Australia (31° 36' S, 118° 6' E). Coll 1971 and subm by J M Bowler.

**N-1301. Hines Hill 1** **19,600 ± 660**  
**17,650 BC**  
From charcoal layer, 1cm thick, distributed over 90cm on undisturbed dune bedding plane.

**N-1302. Hines Hill 2** **17,600 ± 880**  
**15,650 BC**  
From single concentration of charcoal representing burned tree in calcareous sands, 3m below top of dune. *Comment* (JMB): dates relate to building of quartz-gypsum dune on shores of small lake S of Hines Hill.

**N-1303. Unnamed Lake, W Australia** **13,300 ± 170**  
**11,350 BC**  
*Coxiella* shells from near upper layers of dune on E shore of unnamed lake on rd 17km S of L Grace Township, Dumbleyung, W Australia (33° 15' S, 118° 28' E). Coll 1971 and subm by J M Bowler. *Comment* (JMB): due to slight contamination by soil carbonate, age is minimum for last phase of high lake levels.

#### Lake King series

Calcareous sandy clay from lake shore dune (lunette) on E margin of Lake King, W Australia (33° 5' S, 130° 7' E). Coll 1971 and subm by J M Bowler. *Comment*: carbonate component dated. No <sup>13</sup>C correction was made.

**N-1433. Lake King 1** **+1900**  
**16,700**  
**-1600**  
**14,750 BC**  
From 3.5m below dune surface.

**N-1434. Lake King 2** **15,600 ± 970**  
**13,650 BC**  
From 2m below dune surface. *Comment* (JMB): dates are approx for dune building assoc with drying of lake and agree well with predicted age based on established age of similar events in SE Australia.

**N-1436. Lake Mulurulu** **17,300 ± 250**  
**15,350 BC**  
Finely divided organic carbon in fine sand matrix from fireplace assoc with mammal bones (*Bettongia* sp) in core of eroding dune on N shore of L Muruluru, W New South Wales (33° 10' S, 143° 22' E). Coll 1971 and subm by J M Bowler. *Comment* (JMB): reinterpretation of field evidence confirms this sample assoc with Zanci drying phase of lake.

**N-1437. Emu Lake** **12,100 ± 150**  
**10,150 BC**  
Unionid shells from Aboriginal midden in calcareous sandy clays blown from drying lake floor, near S end of Lunette on E margin of lake between Glendes and Glen Emu Sta, 53km N of Balrenald, W New

South Wales (34° 11' S, 143° 43' E). Coll 1972 and subm by J M Bowler. *Comment* (JMB): date provides minimum age for last period of lacustrine activity in which Aborigines harvested shells in this region. Shells overlying calcareous aeolian clay dune in other lakes nearby have been dated at 17,000 to 15,000 BP. Slight contamination by younger soil carbonate may be present.

### Lake George series

Organic and inorganic carbon from core of lacustrine sediments in L George near Canberra (35° 1' S, 149° 24' E). Coll and subm 1973 and 1974 by J M Bowler and G Singh. Samples obtained by matching equivalent stratigraphic horizons in Cores LG1 and LG3 with those of Master Core LG2. In data given below, equivalent depths in master core are indicated.

	<b>7770 ± 110</b>
<b>N-1512. Lake George, C1, inorganic</b>	<b>5820 BC</b>
Depth 85 to 89cm. Carbonate-rich horizon with shell fragments and lime mud. Organic carbon: 0.75%; CaCO <sub>3</sub> : 16.2%.	
	<b>12,400 ± 460</b>
<b>N-1513. Lake George, C4, organic</b>	<b>10,450 BC</b>
Depth 292 to 300cm. Sandy clay with organic matter as small black specks. Organic carbon: 1.66%; CaCO <sub>3</sub> : 0.90%.	
	<b>31,300 ± 1170</b>
<b>N-1514. Lake George, C5, organic</b>	<b>29,350 BC</b>
Depth 309 to 314cm. Sands with organic fragments. Organic carbon: 2.08%; CaCO <sub>3</sub> : 0.22%.	
<b>N-1515. Lake George, C6, inorganic</b>	<b>&gt;37,800</b>
Depth 440 to 445cm. Pale creamy layer of marl. Organic carbon: 0.33%; CaCO <sub>3</sub> : 29.1%.	
	<b>22,500 ± 650</b>
<b>N-1516. Lake George, C7, organic</b>	<b>20,550 BC</b>
Depth 503 to 510cm. Dark gray soil zone with finely divided organic matter. Organic carbon: 1.94%; CaCO <sub>3</sub> : 1.68%.	
	<b>+1650</b>
	<b>23,700</b>
	<b>-1350</b>
<b>N-1517. Lake George, C8, organic</b>	<b>21,750 BC</b>
Depth 646 to 653cm. Finely divided organic matter in zone affected by weak pedogenesis. Organic carbon: 1.45%; CaCO <sub>3</sub> : 0.41%.	
	<b>+3000</b>
	<b>29,600</b>
	<b>-2100</b>
<b>N-1518. Lake George, C9, organic</b>	<b>27,650 BC</b>
Depth 701 to 706cm. Sandy clay with organic specks. Organic carbon: 1.21%; CaCO <sub>3</sub> : 0.03%.	

<b>N-1519. Lake George, C10, inorganic</b>	<b>&gt;37,800</b>
Depth 854 to 860cm. <i>Coxiella</i> shell layer. Organic carbon: 0.48%; CaCO <sub>3</sub> : 5.70%.	
	<b>18,600 ± 930</b>
<b>N-1814-1. Lake George, LG12, inorganic</b>	<b>16,650 BC</b>
Depth 140 to 150cm. Plastic clay with traces of organic matter and carbonate.	
	<b>11,300 ± 510</b>
<b>N-1814-2. Lake George, LG12, organic</b>	<b>9350 BC</b>
Organic carbon fraction of LG12.	
	<b>25,600 ± 460</b>
<b>N-1815-1. Lake George, LG13, inorganic</b>	<b>23,650 BC</b>
Depth 190 to 200cm. Clay with organic traces from 5m below shell layer.	
	<b>+1700</b>
	<b>28,400</b>
	<b>-1500</b>
<b>N-1815-2. Lake George, LG13, organic</b>	<b>26,450 BC</b>
Organic carbon fraction of LG13.	
<b>N-1816-1. Lake George, LG14, inorganic</b>	<b>&gt;37,800</b>
Depth 230 to 240cm. Clay with organic carbon, shell and fine earth carbonate overlying soil contact.	
	<b>27,100 ± 1050</b>
<b>N-1816-2. Lake George, LG14, organic</b>	<b>25,150 BC</b>
Organic carbon fraction of LG14.	
	<b>+4300</b>
	<b>35,700</b>
	<b>-2800</b>
<b>N-1817. Lake George, LG15, organic</b>	<b>33,750 BC</b>
Depth 290 to 300cm. Clays of low organic content. Almost no carbonate.	
	<b>+1700</b>
	<b>30,300</b>
	<b>-1400</b>
<b>N-1818. Lake George, LG16, organic</b>	<b>28,350 BC</b>
Depth 335 to 343cm. From darkish sands with pale layer. Almost no carbonate. Equivalent to N-1514.	
	<b>+1800</b>
	<b>23,000</b>
	<b>-1500</b>
<b>N-1819. Lake George, LG17, organic</b>	<b>21,050 BC</b>
Depth 360 to 370cm. Clay with low organic content. Almost no carbonate. <i>Comment</i> (JMB): organic dates, when considered as a series, show a wide distribution which can only be explained by extensive con- tamination. Inorganic dates show a reasonably consistent time series, <i>i e</i> ,	

top 4 points fall on a relatively straight line as a function of depth, and projection of this line towards top of core is sufficiently close to present ground surface to suggest that results approx valid radiocarbon ages. Further evaluation is required.

**17,100 ± 240**

**N-1655. Tyson's Lake**

**15,150 BC**

Unionid shells from shoreline gravels below gypseous clays in aeolian dune on margin of Tyson's L, near Hatfield, W New South Wales (33° 51' S, 143° 51' E). Coll 1969 and subm by J M Bowler. *Comment* (JMB): expected date is 18,000 to 20,000 BP by comparison with periods of high water phase of other lakes in the region.

**Lake Mungo series**

Sample from various localities around L Mungo, W New South Wales. Coll 1972 and subm by J M Bowler.

**14,500 ± 290**

**N-1656. Lake Mungo, 97s**

**12,550 BC**

Unionid shells from level 1.8m below floor of dry lake in fine-grained clay matrix, Shell Tank, Mungo Sta (33° 45' S, 143° 4' E).

**N-1657. Lake Mungo, 99s**

**>37,800**

Unionid shells in shallow water sands overlying buried soil, ca 1m below N-1656. *Comment* (JMB): date suggests that active lacustrine conditions began prior to ca 40,000 BP following a long period of lake dry conditions as indicated by underlying buried soil.

**N-1658. Lake Mungo, 101s**

**>37,800**

Articulated unionid shells in growth position, 69cm below deflation floor of L Mungo in youngest stratigraphic unit (33° 46' S, 143° 5' E).

**20,800 ± 350**

**N-1659. Lake Mungo, 105**

**18,850 BC**

Calcareous lake sediment from stratigraphic section exposed in trench on E shore of L Mungo (33° 45' S, 143° 7' E). Sediment deposited in shallow water below N-1660.

**21,900 ± 400**

**N-1660. Lake Mungo, 108**

**19,950 BC**

Calcareous tubules believed formed by algal deposition on plants growing in shallow lake, from section as above. *Comment* (JMB): dates for N-1659 and N-1660 overlap at 2σ. Thin sec examination reveals significant recrystallization. Contamination by younger carbon is involved. Dates provide minimum age for deposition of algal carbonates.

**2010 ± 65**

**N-1661. Murray River**

**60 BC**

Unionid shells from Aboriginal midden, 0.5m below surface, in cliffed linear sand dune truncated by Murray R, Boundary Bend, Victoria



(34° 43' S, 143° 8' E). Coll 1973 and subm by J M Bowler. *Comment* (JMB): shells lie in zone of weak pedogenesis and have undergone slight recrystallization to secondary calcite (10%).

**N-1662. Prungle Lake** **>37,800**

Articulated unionid shells in terrace soil, 30cm below surface, ca 300m N of Prungle Sta shearing shed on margin of Prungle L on Willandra Creek, W New South Wales (34° 15' S, 143° 0' E). Coll 1973 and subm by J M Bowler. *Comment* (JMB): minor trace (1%) of secondary calcite is evident in soil profile where shells occur.

**Lake Arumpo series**

Sample from two localities on margin of L Arumpo, W New South Wales. Coll 1973 and subm by J M Bowler.

**N-1663. Lake Arumpo, 113** **>37,800**

Unionid shells in growth position from eroding gypseous sandy clay pan, representing deposits of Outer Arumpo L, on rd opposite old Arumpo shearing shed (33° 49' S, 142° 54' E).

**N-1664. Lake Arumpo, 114b** **22,600 ± 430**  
**20,650 BC**

Unionid shells from Aboriginal midden on Outer Arumpo strand-line, Top Hut Sta (33° 47' S, 143° 0' E). Shells were sealed by clayey sands blown from drying lake floor. *Comment* (JMB): dates aeolian activity.

**N-1665. Lake Arumpo, 115** **+1800**  
**35,600**  
**-1500**  
**33,650 BC**

Unionid shells from occupational layer with charcoal fragments 3.5m below surface of lake sediments, Long Water Hole, Top Hut Sta (33° 46' S, 142° 59' E).

**Redcliffs series**

Unionid shells from Aboriginal midden in dune sands on S bank of Murray R, at Redcliffs, N Victoria (34° 19' S, 142° 17' E). Coll 1967 by Hal Thomas, Australian Natl Univ; subm by J M Bowler.

**N-1666. Redcliffs, 116s** **1110 ± 75**  
**AD 850**

From level 25cm below soil surface.

**N-1667. Redcliffs, 123s** **12,100 ± 150**  
**10,150 BC**

From base of midden, 1.27m below surface. *Comment* (JMB): a previous sample from this midden yielded 11,250 ± 240 (GaK-1062).

+1600  
**32,500**  
 -1300  
**30,550 BC**

**N-1520. Bermagui**

Fibrous peat from power-auger drill hole at ca 6.1m below high water mark, buried by 6 to 7m barrier sand, at Bermagui, S Coast, New South Wales (36° 25' S, 150° 3' E). Coll 1972 by B G Thom, Australian Natl Univ; subm by J M Bowler. *Comment* (BGT): dates organic sedimentation close to sea level during last phase of Holocene Transgression.

**N-1521. Merimbula****>37,800**

Organic clay from power-auger drill hole at 37m below high water mark, buried by 40.5m of barrier and backbarrier sand, at Merimbula, S Coast, New South Wales (36° 40' S, 149° 50' E). Coll 1972 by B G Thom; subm by J M Bowler. *Comment* (BGT): dates quiet water sedimentation during a period of low sea level.

**Sirunki series**

Gyttja samples from various depths of core obtained at Sirunki, New Guinea (5° 20' S, 143° 30' E). Coll by D Walker, Australian Natl Univ; subm 1972 by J M Bowler.

**N-1522. Sirunki, AA1a** **2150 ± 75**  
 From depth 217 to 225cm. **200 BC**

**N-1523. Sirunki, AA2a** **9260 ± 120**  
 From depth 965 to 985cm. **7310 BC**

**N-1524. Sirunki, AA3a** **14,100 ± 175**  
 From depth 1305 to 1323cm. **12,150 BC**

**N-1525. Sirunki, AA4a** **19,900 ± 320**  
 From depth 1633 to 1645cm. **17,950 BC**

**N-1526. Sirunki, GA1** **2580 ± 65**  
 From depth 1 to 17cm. **630 BC**

**N-1527. Sirunki, GA2** **28,900 ± 880**  
 From depth 0 to 40cm. **26,950 BC**

*Comment* (DW): to date horizons in pollen diagram from same core. Series GA is to check stratigraphic correlations between parts of same sediment. GA samples are ca 1km from series AA.

*C. Antarctica*

Sea water, lake water and atmospheric CO<sub>2</sub> samples from E Antarctica. Coll 1969 to 1970 and subm by K Omoto, Tohoku Univ (Omoto, 1972).

**N-858. Sea water** **70.8 ± 1.1% modern**

CO<sub>2</sub> from acidified sea water from depth 10m, Ongul Strait, E of Ongul Is, 4km from continental ice sheet (69° 1' S, 39° 36' E). Coll Jan 20, 1969.

**N-860. Sea water** **89.9 ± 1.2% modern**

CO<sub>2</sub> from acidified sea water from depth 10m. Ca 70km NW of Syowa Sta, Ongul Is, 80km from continental ice sheet (68° 44' S, 38° 42' E). Coll Feb 20, 1970.

**N-859. Lake water** **127.8 ± 1.9% modern**

Lake water from depth 0.5m glacial lake temporarily named Shiro-ike in Skallen, Soya Coast (69° 40' S, 39° 24' E). Coll Feb 3, 1969. Carbon content: 37.5ppm as bicarbonate ion.

**N-861. Lake water** **125.3 ± 1.9% modern**

Lake water from same lake as N-859. Coll Feb 4, 1970. Carbon content: 33.9ppm as bicarbonate ion.

**N-922. Atmospheric CO<sub>2</sub>** **148.7 ± 1.7% modern**

Atmospheric CO<sub>2</sub> coll Apr 23 to May 3, 1969 at Syowa Sta, Ongul Is (69° 0' S, 39° 36' E).

**N-923. Atmospheric CO<sub>2</sub>** **131.5 ± 4.5% modern**

Atmospheric CO<sub>2</sub> coll Oct 20 to 30, 1969 at Syowa Sta. *Comment* (KO): atmospheric CO<sub>2</sub> was coll by absorption in 2N to 8N NaOH solution in plastic tray. Low <sup>14</sup>C concentration of antarctic sea water reported by Broecker and Olson was confirmed (Broecker and Olson, 1961).

## II. PEDOLOGIC SAMPLES

*A. Japan*

Total organic carbon, unless otherwise stated, of samples from humic horizon in volcanic ash and muck from various localities. Coll 1972 to 1973 and subm by Y Yamada, Natl Inst Agric Sci.

**Shiwaya series**

Sample from various depths of humus horizons in volcanic ash soil at Shiwaya, Kanzaki-cho, Kanzaki-gun, Saga Pref (33° 20' N, 130° 23' E).

**N-1463. Shiwaya 1**

**1840 ± 30**  
**AD 110**

From depth 0 to 23cm, A<sub>11</sub> horizon.

**N-1464. Shiwaya 2**

**2230 ± 95**  
**280 BC**

From depth 23 to 64cm, A<sub>12</sub> horizon.

**N-1465. Mitagawa 1**

**1500 ± 90**  
**AD 450**

Sample from depth 0 to 28cm, A<sub>p</sub> horizon, at Mitabaru, Mitagawa-cho, Kanzaki-gun, Saga Pref (33° 20' N, 130° 25' E).

**Asamizo series**

Sample from humic horizon IIB<sub>1</sub>, depth 85 to 100cm, at Asamizo-dai, Sagamihara city, Kanagawa Pref (35° 46' N, 139° 25' E).

**N-1672. Asamizo 7-1** **7320 ± 105**  
**5370 BC**

Total organic carbon. Carbon content: 2.64%.

**N-1503. Asamizo 7-2** **9250 ± 200**  
**7300 BC**

Humic acid fraction of N-1672. *Comment:* samples of other horizons are N-1419 to 1424 (R, 1974, v 16, p 337).

**N-1504. Kitakami 1-2** **Modern**

Sample from depth 7 to 14cm, A<sub>12</sub> horizon, at Murasakino, Kitakami city, Iwate Pref (39° 19' N, 141° 8' E).

**Kuriyagawa series**

Sample from various depths of humus horizons at Akahira, Shimo Kuriyagawa, Morioka city, Iwate Pref (39° 45' N, 141° 8' E).

**N-1505. Kuriyagawa 1-1** **1010 ± 75**  
**AD 940**

From depth 0 to 21cm, A<sub>p</sub> horizon.

**N-1506. Kuriyagawa 1-2** **3760 ± 90**  
**1810 BC**

From depth 21 to 50cm, A<sub>12</sub> horizon.

**N-1507. Kuriyagawa 1-3** **5770 ± 100**  
**3820 BC**

From depth 50 to 67cm, A<sub>3</sub> horizon.

**N-1508. Kuriyagawa 2-1** **915 ± 75**  
**AD 1035**

From depth 11 to 32cm, A<sub>12</sub> horizon.

**N-1509. Tsunanbara 2-2** **1840 ± 80**  
**AD 110**

Sample from depth 20 to 46cm, A<sub>12</sub> horizon, at Miho, Tsunancho, Nakauonuma-gun, Niigata Pref (36° 58' N, 138° 42' E).

**N-1668. Mutsumi 1-5** **4350 ± 90**  
**2400 BC**

Sample from depth 70 to 89cm, IIIA horizon, at Mutsumi-mura, Abu-gun, Yamaguchi Pref (34° 27' N, 131° 36' E). Carbon content: 6.0%.

**N-1669. Yatsugatake 1-2** **1980 ± 80**  
**30 BC**

Sample from depth 22 to 38cm, A<sub>12</sub> horizon, at Oizumi-mura, Kitakoma-gun, Yamanashi Pref (35° 53' N, 138° 24' E). Carbon content: ca 10%.

**2540 ± 65**  
**590 BC**

**N-1670. Kamikunii 3**

Sample from depth 42 to 61cm, A<sub>13</sub> horizon, at Kamikunii, Mito city, Ibaragi Pref (36° 26' N, 140° 26' E). Carbon content: ca 10%.

**500 ± 75**  
**AD 1450**

**N-1671. Ozutsumi 2**

Sample from depth 14 to 31cm, A<sub>12</sub> horizon, at Ozutsumi, Ibaragi-cho, Higashi-Ibaragi-gun, Ibaragi Pref (36° 12' N, 140° 25' E). Carbon content: ca 6%.

*B. Brazil*

Sample from various localities of terrace (terra firme) at Amazon flood plain, Belterra, Santarém, Pará (2° 40' S, 54° 55' W). Coll 1972 and subm by A Iseki, Natl Inst Agric Sci. Sample soil is classified as yellow humic anthropogenic latosol called "terra preta do Indio", distributed patchwise in dark, fertile soil on peripheral part of terrace near river. It often contains potsherds derived from Pre-Colombian Indians (Sombroek, 1966; Falesi, 1970; Vieira, 1971).

**Modern**

**N-1674. Belterra 1**

From depth 0 to 15cm, A<sub>p11</sub> horizon. Carbon content: 4.04%.

**160 ± 65**  
**AD 1790**

**N-1675. Belterra 2**

From depth 15 to 25cm, A<sub>p12</sub> horizon, at same spot as above. Carbon content: 3.00%.

**Modern**

**N-1676. Belterra 3**

From depth 0 to 6cm, A<sub>p1</sub> horizon. Carbon content: 3.25%.

**1660 ± 75**  
**AD 290**

**N-1673. Belterra 4**

From depth 10 to 20cm, A<sub>p11</sub> horizon. Carbon content: 7.29%. *Comment:* total organic carbon for N-1674 to -1676 and humic acid fraction for N-1673 were dated.

III. ARCHAEOLOGIC SAMPLES

*A. Japan*

**Uenoharu series**

Charcoal from site at Uenoharu, Kengun-machi, Kumamoto city, Kumamoto Pref (32° 47' N, 130° 46' E), on edge of Takuma Terrace. Coll 1970; subm by Y Kotani, Kumamoto Univ.

**2700 ± 160**  
**750 BC**

**N-1199. Uenoharu 1**

Charcoal fragments from dwelling pit floor, ca 90cm below surface, in Layer IIAb, dark brown humic loam in which the pit house, burned soils, pottery of Goryo type, stone tools, fragments of clay figurines and plant remains including cereal grains are found.

**N-1200. Uenoharu 2** **3150 ± 125**  
**1200 BC**

Charred nut shells separated from burned soil.

**N-1201. Uenoharu 3** **3380 ± 125**  
**1430 BC**

Same as N-1200. *Comment* (YK): dates earlier manifestations of rice and barley cultivation in Kyushu (Kotani, 1972). Humic loam samples from Layers IIAb, depth 55cm, IIIAb, depth 120cm, and VAb, depth 155cm, yielded  $1810 \pm 90$  BP (GaK-3527),  $9160 \pm 180$  BP (GaK-3526), and  $20,850 \pm 750$  BP (GaK-3525), respectively.

**N-1538. Tokusada** **1290 ± 80**  
**AD 660**

Charcoal fragment of burned House 5, Sq 4P, of Kofun period at Miyota, Tamura-cho, Koriyama city, Fukushima Pref ( $37^{\circ} 21' N$ ,  $140^{\circ} 22' E$ ). Coll by K Watanabe; subm 1973 by Y Takagi, Fukushima Pref Educ Bureau.

**N-1560. Goryogadai** **3570 ± 100**  
**1620 BC**

Charcoal from depth 25 to 40cm of Goryogadai shell mound, Hirokawa, Hiratsuka city, Kanagawa Pref ( $35^{\circ} 21' N$ ,  $139^{\circ} 18' E$ ). Assoc with Middle Jomon pottery of Goryogadai type. Coll by N Murayama, Hiratsuka City Mus; subm by H Morita, Tanseisha Co.

#### Yasakae-Kita series

Charcoal from Yasakae-Kita site, Natsumi-cho, Funabashi city, Chiba Pref ( $35^{\circ} 45' N$ ,  $140^{\circ} 1' E$ ). Site consists of 2 archaeol remains of Early Jomon and Late Kofun periods. Coll 1972 and subm by T Niitsu, Sophia Univ (Yawata *et al*, 1974).

**N-1625. Yasakae-Kita 1** **1650 ± 80**  
**AD 300**

Charcoal from floor of burned Pit 3 of probably Kofun period.

**N-1626. Yasakae-Kita 2** **1680 ± 80**  
**AD 270**

Charcoal from Pit 3.

**N-1627. Yasakae-Kita 3** **1730 ± 80**  
**AD 220**

Charcoal from Pit 6. *Comment* (TN): according to pottery type and pit structure, estimated age is ca 6th century AD.

#### Sotohara series

Charcoal samples from dwelling pits at Sotohara, Takinoi-cho, Funabashi city, Chiba Pref ( $35^{\circ} 40' N$ ,  $140^{\circ} 4' E$ ). Thirteen pits were excavated which yielded Haji Pottery of Izumi type of Early Kofun Period (Yawata *et al*, 1972). Coll 1970 by F Okazaki; subm by I Yawata, Sophia Univ.

**N-933. Sotohara 1** **1790 ± 110**  
**AD 160**  
Charcoal from Pit 4.

**N-934. Sotohara 2** **1800 ± 110**  
**AD 150**  
Burned rice grain from Pit 4.

**N-935. Sotohara 3** **1730 ± 110**  
**AD 220**  
Charcoal from Pit 7.

**N-936. Sotohara 4** **1790 ± 110**  
**AD 160**  
Charcoal from Pit 10. *Comment* (FO): assoc pottery suggests late 5th century AD occupation.

*B. South Pacific*

**Rota Island series, Marianas**

Sample recovered from various depths of an excavated latte (M-1), ruin of capped stone upright site called by modern Chamorros, at Muchon ranch, NE part of Rota Is, Marianas (14° 12' N, 145° 16' E). Artifacts were found from present ground surface to upper Layer III, in which was found Marianas Red Ware of pre-latte period, the oldest pottery type so far found in the Marianas, assoc with a fish hook, sling-stone, coral pendant, and shell beads. Fish and animal bones were coll mainly from Layers I and II (Takayama and Egami, 1971). Coll 1970 to 71 and subm by J Takayama, Tokai Univ.

**N-1009. M-1, Ca No. 1** **600 ± 95**  
**AD 1350**  
Charcoal from Grid C-3, Layer II, depth 27cm.

**N-1010. M-1, Ca No. 2** **410 ± 95**  
**AD 1540**  
Charcoal from Grid A-1, Lower Layer II (from pit in Layer III).

**N-1011. M-1, Ca No. 3** **300 ± 95**  
**AD 1650**  
Charcoal from Grid B-3, Layer I.

**N-1003. M-1, Ca No. 4** **165 ± 80**  
**AD 1785**

*Tridacna* shell from Grid C-3, Upper Layer I. *Comment* (JT): dates show latte (M-1) was constructed somewhat later than AD 1335 ± 100 and still used until 1780 ± 80. Latter date seems to be assoc with end of Spanish conquest and removal of all Chamorros to Guam, except for a handful remaining on Rota, by the close of 17th century AD (Spoehr, 1957).

**Pagan series, Marianas**

Samples from latte site at Regusa, Pagan I., Marianas (18° 23' N, 145° 50' E). Sherds and stone tools, shell, fish and animal bones, and charcoal were found in Layers I and III (Egami and Saito, 1973). Coll 1973 and subm by T Egami, Aoyama Gakuin Univ.

**N-1562. Pagan 1** **275 ± 90**  
**AD 1675**  
Charcoal from G2, Layer III, 42cm below surface.

**N-1563. Pagan 2** **605 ± 85**  
**AD 1345**  
Charcoal from G2, Layer III, 50cm below surface.

**N-1564. Pagan 3** **440 ± 110**  
**AD 1510**  
Charcoal from B0, Layer III, 60cm below surface. *Comment* (TE): dates approx use of latte.

*C. Southeast Asia***Sohoton Cave site series, Philippines**

Sample from Sohoton I, one of the largest cave sites along Basey R, Municipality of Basey, SW Samar, Philippines (11° 22' N, 125° 10' E). Coll 1971 and subm by K L Hutterer, Univ Michigan. Site has 4 archaeol layers which yield an unchanging assemblage of small stone flake and few bone tools to which, in Levels 3 and 4, pottery is added, consisting exclusively in plain globular earthenware vessels, except for a few sherds of highly developed and decorated ware. Assoc with artifacts are faunal remains, such as animal bones, and marine and freshwater shells (Tuggle and Hutterer, 1972; Hutterer, 1974).

**N-1152. Sohoton 1** **385 ± 105**  
**AD 1565**  
Charcoal from hearth area, Sq J22, Layer 2, dry crusty white deposit of calcium carbonate, 3cm thick, overlain by Layer 1 of 2cm thick.

**N-1179. Sohoton 2** **10,200 ± 150**  
**8250 BC**  
Soil with guano from depth ca 1m.

**Niah Great Cave series, Borneo**

Bones from site in West Mouth of Niah Great Cave, W Sarawak, Borneo (3° 48' N, 113° 47' E), where 166 Stone-age burials were excavated (Harrisson, 1967; Brooks and Brooks, 1969; Heglar and Brooks, 1973). Coll 1966 and subm 1972 by R H Brooks and S Brooks, Univ Nevada, Las Vegas. *Comment*: unless otherwise stated, organic fraction of bone was dated. Measurements on charcoal and wood were done by Groningen (Vries and Waterbolk, 1958; Vogel and Waterbolk, 1964) and by Geochron (GXO-720B, 721).



<b>N-1329. Burial 3</b>	<b>1870 ± 75</b> <b>AD 80</b>
Extended burial from depth 20 to 46cm, Trench HH4.	
<b>N-1330. Burial 10</b>	<b>3320 ± 120</b> <b>1370 BC</b>
Extended burial from depth ca 30cm, Trench HH5.	
<b>N-1331. Burial 30</b>	<b>3710 ± 470</b> <b>1760 BC</b>
Burned burial from depth ca 25cm, Trench DE3.	
<b>N-1332. Burial 36</b>	<b>2800 ± 80</b> <b>850 BC</b>
Extended burial from depth ca 61cm, Trench DN2-DE.	
<b>N-1333. Burial 50</b>	<b>2210 ± 150</b> <b>260 BC</b>
Extended burial from depth ca 30cm, Trench L5.	
<b>N-1334. Burial 54</b>	<b>10,600 ± 510</b> <b>8650 BC</b>
Disarticulated skeleton with skull from depth ca 5cm, Trench L4. <i>Comment:</i> bone apatite dated.	
<b>N-1335. Burial 57</b>	<b>2520 ± 130</b> <b>570 BC</b>
Extended burial from depth 30 to 38cm, Trench K2.	
<b>N-1336. Burial 60A</b>	<b>2960 ± 115</b> <b>1010 BC</b>
Extended burial from depth 30cm, Trench K4.	
<b>N-1337. Burial 66</b>	<b>6850 ± 600</b> <b>4900 BC</b>
Cremation in coffin from depth 20 to 30cm, Trench JIA. <i>Comment:</i> bone apatite dated.	
<b>N-1338. Burial 67</b>	<b>2630 ± 80</b> <b>680 BC</b>
Burned burial in jar from depth ca 10cm, Trench JA1.	
<b>N-1339. Burial 68</b>	<b>3660 ± 100</b> <b>1710 BC</b>
Extended burial from depth 38 to 43cm, Trench JA1(A).	
<b>N-1340. Burial 69</b>	<b>3170 ± 100</b> <b>1220 BC</b>
Burned burial from depth ca 30cm, Trench J1(B).	
<b>N-1341. Burial 75</b>	<b>2630 ± 375</b> <b>680 BC</b>
Extended burial from depth ca 30cm, Trench M5. <i>Comment:</i> bone apatite dated.	

<b>N-1342. Burial 76</b>	<b>4160 ± 90</b> <b>2210 BC</b>
Extended burial from depth ca 25cm, Trench M5.	
<b>N-1343. Burial 77</b>	<b>3580 ± 70</b> <b>1630 BC</b>
Flexed burial from depth ca 71cm, Trench X3.	
<b>N-1344. Burial 83</b>	<b>8000 ± 255</b> <b>6050 BC</b>
Seated burial from depth ca 91cm, Trench EB4. <i>Comment:</i> bone apatite dated.	
<b>N-1345. Burial 89</b>	<b>Modern</b>
Seated burial from depth ca 64cm, Trench W1.	
<b>N-1346. Burial 92</b>	<b>7140 ± 165</b> <b>5190 BC</b>
Disarticulated skeleton excluding skull from depth ca 122cm, Trench X5.	
<b>N-1347. Burial 102</b>	<b>2660 ± 80</b> <b>710 BC</b>
Extended burial from depth ca 23cm, Trench H10.	
<b>N-1348. Burial 110</b>	<b>4990 ± 90</b> <b>3040 BC</b>
Extended burial from depth ca 23cm, Trench J4.	
<b>N-1349. Burial 115</b>	<b>4650 ± 195</b> <b>2700 BC</b>
Extended burial from depth ca 30cm, Trench J3+J2.	
<b>N-1350. Burial 123</b>	<b>3490 ± 155</b> <b>1540 BC</b>
Extended burial from depth ca 46cm, Trench H9-HH10.	
<b>N-1351. Burial 125</b>	<b>2730 ± 120</b> <b>780 BC</b>
Extended burial from depth ca 2.5cm, Trench H12-H3.	
<b>N-1352. Burial 133</b>	<b>2980 ± 85</b> <b>1030 BC</b>
Extended burial from depth ca 30cm, Trench JH5-JH2.	
<b>N-1353. Burial 135</b>	<b>2880 ± 390</b> <b>930 BC</b>
Cremation of several individuals with red ocher deposit from depth ca 20cm, Trench JH5. <i>Comment:</i> bone apatite dated.	

	<b>+1550</b>
	<b>11,400</b>
	<b>-1350</b>
<b>N-1354. Burial 146</b>	<b>9450 BC</b>
Seated burial from depth ca 51cm, Trench ED2. <i>Comment:</i> bone apatite dated.	
	<b>7020 ± 135</b>
<b>N-1355. Burial 147</b>	<b>5070 BC</b>
Seated burial from depth ca 91cm, Trench ED2.	
	<b>550 ± 100</b>
<b>N-1356. Burial 148</b>	<b>AD 1400</b>
Flexed burial from depth ca 91cm, Trench ED2.	
	<b>7850 ± 175</b>
<b>N-1357. Burial 155</b>	<b>5900 BC</b>
Flexed burial from depth ca 46cm, Trench CD44.	
	<b>2620 ± 80</b>
<b>N-1358. Burial 177</b>	<b>670 BC</b>
Burned burial from depth ca 13cm, Trench H13.	

**Non Nok Tha series, Thailand**

Bones from site at Non Nok Tha, a mound ca 500m S of Ban Na Di, NW Phu Wiang Dist, Khon Kaen Prov, Thailand (16° 48' N, 102° 18' E). Coll 1968 by D T Bayard, Univ Otago; subm by W G Solheim II, Univ Hawaii. Twelve occupational and/or weathering layers represent Pre-metal and Bronze periods characterized mainly by burials and debris from burials. *Comment:* organic fraction of bone dated except for N-1324 and -1362, which were dated on bone apatite.

	<b>1010 ± 85</b>
<b>N-1324. Non Nok Tha 1</b>	<b>AD 940</b>
Bone from Burial 8, Level I.	
	<b>2160 ± 195</b>
<b>N-1325. Non Nok Tha 2</b>	<b>210 BC</b>
Bone from Burial 14, Level I.	
	<b>1580 ± 115</b>
<b>N-1326. Non Nok Tha 3</b>	<b>AD 370</b>
Bone from Burial 52, Level III.	
	<b>2440 ± 125</b>
<b>N-1327. Non Nok Tha 4</b>	<b>490 BC</b>
Bone from Burial 78, Level II.	
	<b>2420 ± 75</b>
<b>N-1328. Non Nok Tha 5</b>	<b>470 BC</b>
Bone from Burial 88, Level II.	

**N-1362. Non Nok Tha 6****1820 ± 220****AD 130**

Bone from Burial 90, Level III. *Comment* (DTB): 26 radiocarbon dates for Non Nok Tha, 25 on charcoal and 1 on bone collagen, were previously measured at 5 labs, and apparently form 2 sequences: late and early (Bayard, 1971). These additional 6 dates confirm the existence of a 3rd, later sequence. Dates N-1326-1328 and N-1362, while internally consistent with stratigraphy of site, are ca 3000 yr later than expected, based on the early sequence, and too recent to support even the late sequence. N-1324 and -1325 are even more recent and inverted with respect to other 4. N-1324 is definitely incorrect, on historical evidence; it comes from very secure Neolithic burial. An apatite date, N-1362, disagrees with a collagen date ( $2595 \pm 95$ , I-5324) from the same skeleton of N-1362. These 6 dates, as well as 25 charcoal and 4 thermoluminescence dates are discussed in detail elsewhere (Bayard, 1973).

*D. Southwest Asia***Amud Cave series, Israel**

Animal bones from various depths of floor of Amud Cave, 10km N of Tiberias, Upper Galilee Dist, N Israel (32° 52' N, 35° 30' E). Coll 1961 and 1964 in Tokyo Univ Sci Expedition to Asia; subm by K Chinzei, Univ Tokyo. Cave lies ca 800m upstream from Zuttiyeh Cave, on right bank of Wadi Amud, ca 35m above floor of Wadi. Outer half of floor is covered with deposits ca 2m, divided into Amud A and B. Amud B contains Paleolithic deposits including a human skeleton (Suzuki and Takai, 1970). *Comment*: unless otherwise stated, organic fraction was separated by treatment with 1N HCl under vacuum and dated (Krueger, 1965).

**N-763. Amud 1****9010 ± 160****7060 BC**

Organic fraction of bone from Lower B<sub>1</sub>, 80 to 90cm from top of Amud B. Carbon recovery: 0.73%.

**N-765. Amud 2****7340 ± 150****5390 BC**

Organic fraction of bone from same depth as and adjacent to N-763. Carbon recovery: 1.0%.

**N-786. Amud 3****10,700 ± 190****8750 BC**

Organic fraction of bone from same sample as N-763. *Comment*: crushed and sieved bone was treated first with 6N HCl, next with 2N HCl, washed with water and then treated for 1h with hot 0.1N NaOH (Lowdon *et al*, 1969). Carbon recovery: 0.52%.

**N-785. Amud 4****11,700 ± 200****9750 BC**

Inorganic fraction of above sample. *Comment*: sample was treated with 1N HCl to remove calcareous silt adhered on its surface, crushed

and sieved, then treated with 6N HCl for evolution of CO<sub>2</sub>. Carbon recovery: 1.2%.

**N-764. Amud 5** **11,500 ± 250**  
**9550 BC**

Organic fraction of bone from Upper B<sub>2</sub>, 130 to 140cm from top of Amud B. Carbon recovery: 1.1%.

**N-766. Amud 6** **14,700 ± 310**  
**12,750 BC**

Organic fraction of bone from Upper B<sub>2</sub>, 140 to 150cm from top of Amud B. Carbon recovery: 0.53%.

**N-854. Amud 7** **14,400 ± 350**  
**12,450 BC**

Organic fraction of bone from Middle B<sub>2</sub>, 180 to 210cm from top of Amud B. *Comment:* sample treated as for N-786. Carbon recovery: 0.54%.

**N-852. Amud 8** **13,100 ± 230**  
**11,150 BC**

Inorganic fraction of above sample, treated as for N-785. Carbon recovery: 1.9%.

**N-767. Amud 9** **15,700 ± 370**  
**13,750 BC**

Organic fraction of bone from Middle B<sub>2</sub>, 210 to 220cm from top of Amud B. Carbon recovery: 0.50%.

**N-768. Amud 10** **18,300 ± 400**  
**16,350 BC**

Organic fraction of bone from Basal B<sub>4</sub>, 320 to 340cm from top of Amud B. Carbon recovery: 0.88%.

*General Comment* (KC): Amud B industry bears “transitional” character between Levallois-Mousterian and upper Paleolithic; thus, Amud B is apparently younger than fluvial sand bed in Zuttiyeh Cave, 800m downstream, underlying deposits containing middle Paleolithic, Mousterian stone implements. By its elev from floor of present Wadi, the fluvial bed in Zuttiyeh Cave is possibly correlated with Lisan series in S of Lake Tiberias, which is supposedly sediments of great pluvial lake that appeared in Jordan Rift valley during last glacial period (Picard, 1943, 1965).

Lisan lake dried up toward the end of the upper Paleolithic. The dry condition during the Amud B deposition as postulated from sedimentary characteristics and faunal composition may be compared with the warm and dry stage at similar cultural horizons, such as Haua Fteah and Shanidar caves. Similar climatic conditions and cultural horizons also occur in Wad and Tabun caves of Mt Carmel, Kafzeh Cave, and Yabrud Cave. According to some radiocarbon dates on charcoal and burned animal bones from these caves and other archaeol remains in E Mediterranean, mainly from Groningen Lab, “transitional” period could be 30,000 to 40,000 BP.

Present dates are much younger than expected, based on prehistoric and geologic correlations with other deposits in W Asia and N Africa. Discrepancy is probably due to contamination of samples by younger organic carbon. Difference of dates of N-763 and -786 suggests contamination with alkali-soluble humic substances. Older date of N-785 might be due to substitution of carbonate ions in bone structure with those from surrounding Tertiary limestone. N-786 probably is most reliable age of the horizon of the 3 samples. Since it is not certain that treatment for N-786 was sufficient to remove all contamination the date 10,700 BP should be considered the lower limit of true age.

*E. North America*

**Trowbridge site series (14WY1)**

Charcoal from trash-filled storage pits at Area B of Trowbridge site, a Kansas City Hopewell Village (Bell, 1975; Johnson, 1972; Johnson & Johnson, 1975), Kansas City (39° 8' N, 94° 43' W). Coll and subm 1970 by A E Johnson, Univ Kansas.

**N-970. Trowbridge Site 1** **1630 ± 100**  
**AD 320**  
Charcoal from Feature 1.

**N-971. Trowbridge Site 2** **1820 ± 105**  
**AD 130**  
Charcoal from Feature 2.

**N-972. Trowbridge Site 3** **1690 ± 100**  
**AD 260**  
Charcoal from Feature 3.

**N-973. Trowbridge Site 4** **1590 ± 125**  
**AD 360**  
Charcoal from Feature 4.

**N-974. Trowbridge Site 5** **1550 ± 105**  
**AD 400**  
Charcoal from Feature 8.

**Deister Site series (23PL2)**

Charcoal from trash-filled storage pits at Deister site, a Kansas City Hopewell Village (Katz, 1974), Kansas City (39° 6' N, 94° 35' W). Coll and subm 1970 by A E Johnson.

**N-966. Deister Site 1** **1520 ± 85**  
**AD 430**  
Charcoal from Feature 205.

**N-967. Deister Site 2** **1680 ± 100**  
**AD 270**  
Charcoal from Feature 206.

**N-968. Deister Site 3** **1680 ± 105**  
**AD 270**  
Charcoal from Feature 209.

**N-969. Deister Site 4** **1670 ± 105**  
**AD 280**  
Charcoal from Feature 303.

**N-1055. Deister Site 5** **1290 ± 100**  
**AD 660**  
Charcoal from Feature 9.

**N-1056. Deister Site 6** **1500 ± 100**  
**AD 450**  
Charcoal from Feature 210.

**N-1057. Deister Site 7** **910 ± 110**  
**AD 1040**  
Charcoal from Stain 91.

**Kelley site series (14DP11)**

Charcoal from Kelley site, a Kansas City Hopewell Village (Katz, 1969), Doniphan Co, Kansas (39° 59' N, 95° 19' W). Coll and subm 1971 by A E Johnson.

**N-1058. Kelley Site 1** **1210 ± 100**  
**AD 740**  
Charcoal from Feature 6.

**N-1059. Kelley Site 2** **1100 ± 100**  
**AD 850**  
Charcoal from Feature 10.

**N-1060. 14MM26** **1160 ± 100**  
**AD 790**  
Charcoal from Site 14MM26, Miami Co, Kansas. Site pertains to Kansas City Hopewell complex, Component B, Middle Woodland (Artz *et al*, 1975). Coll and subm 1971 by A E Johnson.

**N-1197. Young site (23PL4)** **1990 ± 110**  
**40 BC**  
Charcoal from Young site, Platte Co, Missouri (39° 12' N, 94° 46' W). Site pertains to Kansas City Hopewell complex, Middle Woodland. Coll and subm 1971 by A E Johnson.

**N-1198. Neiman site (23PL51)** **1840 ± 115**  
**AD 110**  
Charcoal from Neiman site, Platte Co, Missouri (39° 15' N, 94° 46' W). Site pertains to Kansas City Hopewell complex, Middle Woodland. Coll and subm 1971 by A E Johnson.

**Fisher-Gabert site series**

Charcoal from Fisher-Gabert site (23SA128), Missouri (39° 19' N, 92° 12' W). Site is of Central Missouri Middle Woodland with Hope-

well affiliations but somewhat distinct from Kansas City Hopewell. Coll and subm 1971 by A E Johnson.

**N-1049. Fisher-Gabert Site 1** **1820 ± 100**  
**AD 130**  
Charcoal from Feature 3, 42S/40E.

**N-1050. Fisher-Gabert Site 2** **1630 ± 100**  
**AD 320**  
Charcoal from Feature 6, 42S/36E.

**N-1051. Fisher-Gabert Site 3** **1630 ± 100**  
**AD 320**  
Charcoal from Feature 12, 42S/36E.

**N-1052. Fisher-Gabert Site 4** **1560 ± 100**  
**AD 390**  
Charcoal from Feature 20, 44S/34E.

**N-1053. Fisher-Gabert Site 5** **1640 ± 100**  
**AD 310**  
Charcoal from Feature 22, 40S/40E.

**N-1054. Fisher-Gabert Site 6** **1460 ± 105**  
**AD 490**  
Charcoal from Feature 25, 44S/32E.

**Coffey site series (14P01)**

Charcoal from Coffey site, Pottawatomie Co, Kansas (39° 33' N, 96° 33' W). Site is of Archaic occupation. Coll and subm 1972 by A E Johnson.

**N-1549. Coffey Site 1** **4840 ± 95**  
**2890 BC**  
Charcoal from Zone A, N508E500, Feature 2.

**N-1550. Coffey Site 2** **5680 ± 130**  
**3730 BC**  
Charcoal from Zone C, N505E502.

**N-1551. Snyder site (14BU9)** **4150 ± 110**  
**2200 BC**  
Charcoal from hearth, 250cm below surface, Snyder site, Butler Co, Kansas (37° 52' N, 96° 49' W). Site is of Archaic occupation (Grosser, 1973). Coll and subm by A E Johnson. *Comment:* other dates for Snyder site: N-1276 to -1280 (R, 1974, v 16, p 340).

**N-1552. Faulconer site (14BU50)** **3100 ± 165**  
**1150 BC**  
Charcoal from area immediately below upper hearth, Faulconer site, Butler Co, Kansas (37° 50' N, 96° 49' W). Site is of Archaic occupation (Bradley, 1973). Coll and subm 1972 by A E Johnson.



**755 ± 100**

**N-1036. Tobico site (20BY32)** **AD 1195**

Charcoal from Level 4, Feature 3, Unit 500R530 at Tobico site, Kawkawlin Township, Bay Co, Michigan (41° 45' N, 83° 56' W). Coll 1970 by R Dawson; subm by K C Carstens, Washington Univ (Carstens, 1972).

**1210 ± 75**

**N-1554. Black Bluff site** **AD 740**

Charred supporting post from Mimbres (Mangus phase) house, Rm 1, Post Area E, at Black Bluff site, T 17S, R 17W, Grant Co, New Mexico (32° 45' N, 108° 30' W). Coll 1972 by F V Brunnett; subm by J E Fitting, Michigan Hist Div. *Comment* (JEF): date is ca 100 yr earlier than anticipated but well within time range for Mangus phase in this part of New Mexico.

**Winn Canyon site series**

Charcoal from Winn Canyon site, T 15S, R 17W, Grant Co, New Mexico (33° N, 108° 30' W). Coll 1972 and subm by J E Fitting. Site is an early Mogollon site of Pine Lawn or Georgetown phase, a pit house village with only plain brown ware ceramics (Fitting, 1973).

**2300 ± 170**

**N-1555. Winn Canyon Site 1** **350 BC**

From pit, Feature 10, in floor of Rm 2, a large circular subterranean ceremonial rm or kiva.

**1640 ± 80**

**N-1556. Winn Canyon Site 2** **AD 310**

From fill of pit in Rm 6, a domestic room. *Comment* (JEF): date of N-1555 is several centuries earlier, while date of N-1556 is slightly later than anticipated. Both dates bracket Pine Lawn phase.

**Dark Thunder Canyon series**

Material from caves at Dark Thunder Canyon, T 15S, R 21W, and T 16S, R 21W, Grant Co, New Mexico (32° 55' N, 108° 55' W). Coll 1972 and subm by J E Fitting (1972a).

**1110 ± 75**

**N-1557. Dark Thunder Canyon 1** **AD 840**

Part of log from Cave DT-1, assoc with large corrugated ollas that suggest early Reserve phase date of ca AD 1000.

**1730 ± 85**

**N-1558. Dark Thunder Canyon 2** **AD 220**

Charcoal from Feature 1, large sotol roasting pit, in Cave DT-20. *Comment* (JEF): date of N-1557 is ca 200 yr earlier than expected but well within time range for Reserve phase occupation. Date of N-1558 is acceptable for a non-ceramic site of Pine Lawn phase.

**N-1588. Villareal Site No. 2 (G-19)** **950 ± 75**  
**AD 1000**

Part of roof beam from floor of Pit Rm 1, Sec 13, at Villareal site, Grant Co, New Mexico (32° 59' N, 108° 33' W). Coll 1972 by S Lekson; subm by J E Fitting. *Comment* (JEF): date is much earlier than expected and indicates that all of Animas culture does not postdate Mimbres culture but contains a distinct ethnic unit contemporary with late Mimbres occupation of Cliff-Gila Valley (Lekson and Klinger, 1973).

**N-1589. Eaton site (G-25)** **2200 ± 80**  
**250 BC**

Charcoal from Feature 2, deep roasting pit, Sec 12, Grant Co, New Mexico (33° 1' N, 108° 33' W). Coll 1973 by R Zurel; subm by J E Fitting. *Comment* (JEF): date agrees with cultural material (Fitting, 1972b).

**N-1640. Marquette Mission site** **555 ± 85**  
**AD 1395**

Charred wood from Feature 42 at Marquette Mission site in Chippewa Co, Michigan (45° 52' N, 84° 40' W), from a presumed cellar of a Jesuit Mission built in AD 1673 and burned in AD 1706. Coll and subm 1973 by J E Fitting. *Comment* (JEF): date is 3 centuries too early to relate to mission, yet sample was clearly from a French feature. Sample suggests re-use of older wood in a newer structure.

**Chiapas series**

Charcoal and shell samples from 3 shell midden sites ca 6.5km inland from coast of Chiapas, S Mexico (15° 10' N, 92° 50' W). Coll 1973 and subm by B Voorhies, Univ California, Santa Barbara. Artifacts were scarce in aceramic sediments and restricted to obsidian flakes, chipped stone tools, and grinding stones. Deposits are from late Archaic period, 7200 to 2000 BC (Coe, 1967; Johnson and McNeish, 1972; Pinã Chan, 1960; Stone, 1972).

**N-1594. Chiapas 1** **3770 ± 85**  
**1820 BC**

Charcoal from Level 9.8 to 10m, Pit N3E3, Site CS-8.

**N-1595. Chiapas 2** **1900 ± 95**  
**AD 50**

Charcoal from Level 1 to 1.2m, Pit N0E2, Site CS-7. From uppermost stratum.

**N-1596. Chiapas 3** **4600 ± 75**  
**2650 BC**

Charcoal from a burial with aceramic deposits, Level 4.6 to 4.7m, Pit N0E2, Site CS-7.

- 4020 ± 85**  
**2070 BC**
- N-1597. Chiapas 4**  
Charcoal from Level 2.40 to 2.45m, Pit N0E2, Site CS-7. Aceramic stratum.
- 3930 ± 70**  
**1980 BC**
- N-1598. Chiapas 5**  
Charcoal from Level 2.48 to 2.60m, Pit N0E2, Site CS-7. Aceramic stratum.
- 4050 ± 85**  
**2100 BC**
- N-1599. Chiapas 6**  
Charcoal from Level 5.4 to 5.6m, Pit N1E9, Site CS-6. Lowest sample from aceramic stratum.
- 3980 ± 85**  
**2030 BC**
- N-1600. Chiapas 7**  
Charcoal from Level 3.4 to 3.6m, Pit N1E9, Site CS-6. Uppermost sample from aceramic deposits.
- 3890 ± 85**  
**1940 BC**
- N-1601. Chiapas 8**  
Charcoal from Level 6.6 to 6.8m, Pit N8W1, Site CS-6. Lowest sample from aceramic stratum.
- 4350 ± 90**  
**2400 BC**
- N-1887. Chiapas 9**  
Charcoal from Level 5.4 to 5.6m, Pit N0E2, Site CS-7. Aceramic stratum.
- 4450 ± 90**  
**2500 BC**
- N-1888. Chiapas 10**  
Charcoal from Level 5.8 to 6m, Pit N0E2, Site CS-7. Aceramic stratum.
- 4320 ± 90**  
**2370 BC**
- N-1889. Chiapas 11**  
Charcoal from Level 6.4 to 6.6m, Pit N0E2, Site CS-7. Aceramic stratum.
- 3960 ± 90**  
**2010 BC**
- N-1891-1. Chiapas 12**  
Charcoal from Level 8.4 to 8.6m, Pit N3E3, Site CS-8. Aceramic stratum.
- 3710 ± 90**  
**1760 BC**
- N-1891-2. Chiapas 13**  
Shell from Level 8.4 to 8.6m, Pit N3E3, Site CS-8. Aceramic stratum.

*F. Africa***Karkarichinkat series, Mali**

Sample from 2 sites of Karkarichinkat in Tilemsi Valley, N of Gao, Mali (16° 52' N, 0° 12' E). Sites are Neolithic and contain plant and

animal remains. Coll and subm 1972 by A B Smith, Univ California, Berkeley.

**N-1394. Karkarichinkat Sud 1** **3640 ± 100**  
**1690 BC**

Charcoal from 10 to 20cm below surface.

**N-1395. Karkarichinkat Sud 2** **3960 ± 160**  
**2010 BC**

Charcoal from 140cm below surface.

**N-1396. Karkarichinkat Nord 1** **3950 ± 90**  
**2000 BC**

Charcoal and wood from 210cm below surface.

**N-1397. Karkarichinkat Nord 2** **3710 ± 85**  
**1760 BC**

Charcoal from 120cm below surface.

**N-1398. Karkarichinkat Nord 3** **3620 ± 80**  
**1670 BC**

Charcoal from 40cm below surface. *Comment* (ABS): dates expand animal domestication from Saharan regions into W Africa (Smith, 1974). Other date from Karkarichinkat Sud: 3310 ± 110 (Gif-851, R, 1971, v 13, p 224).

#### **Shemara series, Rhodesia**

Charcoal from ancient occupation at Shemara, Umtali Dist, Rhodesia (18° 56' S, 32° 27' E). Coll by G C Solomons and G Lewis, Founders High School; subm 1972 by T N Huffman, Queen Victoria Mus. *Comment* (TNH): Shemara is a single component village that belongs to 2nd phase of Gokomere Early Iron age tradition. Dates agree with similar sites of Makuru and Coronation Park: N-1275 and -978, R, 1974, v 16, p 356.

**N-1547. Shemara 1** **1290 ± 75**  
**AD 660**

From depth 120 to 130cm.

**N-1548. Shemara 2** **1150 ± 75**  
**AD 800**

From depth 150cm.

#### **Rim series, Upper Volta**

Sample from various depths of Areas B and D, in Rim site, Ouahi Gouya Dist, alt ca 340m, Upper Volta, W Africa (13° 43' N, 2° 31' W). Coll 1971 and 1972 and subm by B Wai Andah, formerly, Univ Ghana, now, Univ Ibadan.

**N-1203. Rim J-1-71** **1860 ± 110**  
**AD 90**

Charcoal from lower level, depth ca 1m, of uneroded remnants of coarse red sand in Excav Unit R10, Area B. Natural deposit intervening between Upper, Rim III, and Lower, Rim II, cultural level.

**N-1260. Rim F-1-72** **1510 ± 220**  
**AD 440**

Bone from pot burial complex at E wing of test trench, Area B, assoc with upper occupation level, Rim IIIa.

**N-1366. Rim M-4-72** **Modern**

Bone from pot burial in Excavation Unit R12, Area B, believed assoc with younger, or more recent phase, of upper occupational level, Rim IIIa. State of preservation suggests possible contamination.

**N-1367. Rim R9** **3510 ± 250**  
**1560 BC**

Bone from 80cm depth in Excavation Unit R9, probably intrusive from a cultural level related to lower occupation, Rim II, although it occurs in top level of lowest occupation level, *ie*, Rim I.

**N-1204. Rim S-1-71** **970 ± 190**  
**AD 980**

Charcoal from possible hearth, depth 20cm, in Excavation Unit E6, Area D, assoc with 1st, or older, phase of upper occupation level, Rim IIIb.

**N-1168. Rim S-2-71** **1000 ± 100**  
**AD 950**

**N-1261. Rim F-2-72** **1360 ± 85**  
**AD 590**

Both are charcoal from depth 40cm from datum in Excavation Unit E6, Area D, assoc with 1st, older, phase of upper occupation level, Rim IIIb.

**N-1363. Rim M-1-72** **2840 ± 80**  
**890 BC**

Charcoal from possible hearth in upper sec of lower occupation in Excavation Unit D7, Area D, depth 55 to 60cm below datum.

**N-1364. Rim M-2-72** **3130 ± 80**  
**1180 BC**

Charcoal from depth 60 to 70cm below datum, from Excavation Unit D7, Area D, lower sec of lower occupation.

**N-1205. Rim J-3-71** **3630 ± 120**  
**1680 BC**

Charcoal from fine brown sands underlying coarse red sands at depth 70 to 85cm in test trench, Area D.

*General Comment* (BWA): site is in a valley with natural sandy deposits. Later Stone age to Neolithic occupation phases are distinguished. Apart from N-1168, all dates are consistent with stratigraphy. Dates confirm that burials in Area B are contemporaneous with upper occupation level and suggest some contemporaneity with lower occupation deposits at Area D.

Date obtained for fine brown aeolian sands, N-1205, clearly reflects distinct stratigraphic break noticed in the field.

**N-1365. Wairegaigu** **1080  $\pm$  130**  
**AD 870**

Charcoal from possible refuse dump area at depth 45 to 55cm below surface, in Iron age settlement at Wairegaigu, near Soffokel, Dori, NE Upper Volta (14° 40' N, 0° 18' E). Coll 1972 and subm by B Wai Andah.

#### IV. BONE COLLAGEN DATES

Bone collagen dates were compared with those based on assoc charcoal or shell samples or those estimated by stylistic study on assoc pottery to test their reliability. Most samples were coll from archaeol sites in Hokkaido and subm 1971 and 1973 by N Shimoda, Medical Coll Japan, who measures manganese and fluorine contents of bones for dating purposes (Shimoda, 1972a; Shimoda, 1972b).

##### Ponnai series

Sample from Ponnai, Motowanishi, Muroran city, Hokkaido (41° 56' N, 141° 12' E). Site assoc with pottery of Early Jomon, Ento-Kaso type, to Middle Jomon, Ento-Joso type, periods. Coll by S Mizoguchi and N Shimoda.

**N-1087-1. Ponnai 1, bone collagen** **5860  $\pm$  240**  
**3910 BC**  
From depth 160 to 175cm.

**N-1087-3. Ponnai 1, shell** **5080  $\pm$  160**  
**3130 BC**  
Shell (*Meretrix lusoria*) assoc with N-1087-1.

**N-1088-1. Ponnai 2, bone collagen** **1710  $\pm$  150**  
**AD 240**  
From depth 98cm.

**N-1088-3. Ponnai 2, shell** **5360  $\pm$  130**  
**3410 BC**  
Shell (*Meretrix lusoria*) assoc with N-1088-1.

##### Toi series

Sample from Higashihama shell mound, Toi-machi, Kameda-gun, Hokkaido (41° 19' N, 141° 3' E). Coll 1968 by H Chiyo. Site is probably Middle to Late Jomon period, assoc with Ento-Joso type pottery.

**N-1091-1. Toi, bone collagen** **3720  $\pm$  430**  
**1770 BC**

**N-1091-3. Toi, shell** **3690  $\pm$  140**  
**1740 BC**  
Pelecypod and gastropod shell.

**Shiranuka series**

Sample from site at Shiranuka-cho, Shiranuka-gun, Hokkaido (42° 57' N, 144° 6' E), from shell-bearing layer, depth 10 to 21cm below surface, overlying dark soil with Satsumon, Okhotsk and Midorigaoka type pottery. Coll by K Tominaga.

<b>N-1092-1. Shiranuka, bone collagen</b>	<b>Modern</b>
	<b>1160 ± 100</b>
<b>N-1092-3. Shiranuka, shell</b>	<b>AD 790</b>

**Usu series**

Sample from shell mound at Usu dune, Date-machi, Usu-gun, Hokkaido (42° 6' N, 141° 4' E). Coll 1969 by I Mineyama and N Shimoda. Assoc pottery is of Esan type.

<b>N-1093-1. Usu, bone collagen</b>	<b>1730 ± 115</b>
	<b>AD 220</b>
<b>N-1093-2. Usu, charcoal</b>	<b>605 ± 105</b>
	<b>AD 1345</b>
Charred wood from volcanic ash layer overlying shell layer.	
<b>N-1093-3. Usu, shell</b>	<b>2090 ± 105</b>
	<b>140 BC</b>

**Kitakogane series**

Sample from Kitakogane shell mound, Date-machi, Usu-gun, Hokkaido (41° 59' N, 141° 10' E). Coll 1968 by I Mineyama and N Shimoda. Assoc pottery is of Ento-Joso type.

<b>N-1094-1. Kitakogane, bone collagen</b>	<b>4850 ± 360</b>
	<b>2900 BC</b>
<b>N-1094-2. Kitakogane, charcoal</b>	<b>4800 ± 140</b>
	<b>2850 BC</b>
<b>N-1094-3. Kitakogane, shell</b>	<b>5250 ± 130</b>
	<b>3300 BC</b>

**Etomo series**

Sample from shell mound, Sq 25, at Etomo-machi, Muroran city, Hokkaido (41° 53' N, 141° 10' E). Coll 1969 by N Shimoda. Kamegaoka type pottery is assoc.

<b>N-1095-1. Etomo 1, bone collagen</b>	<b>1870 ± 115</b>
	<b>AD 80</b>
<b>N-1095-2. Etomo 1, charcoal</b>	<b>1540 ± 135</b>
	<b>AD 410</b>
<b>N-1095-3. Etomo 1, shell</b>	<b>2450 ± 125</b>
	<b>500 BC</b>

**Wakkaoi series**

Sample from shell mound at Wakkaoi, Date-machi, Usu-gun, Hokkaido (42° 10' N, 141° 8' E). Assoc with Ento-Kaso type pottery.

**N-1098-1. Wakkaoi, bone collagen** **4550 ± 200**  
**2600 BC**

**N-1098-3. Wakkaoi, shell** **5470 ± 120**  
**3520 BC**

**N-1732. Yoshii** **6780 ± 160**  
**4830 BC**

Collagen of fossil bone from shell mound at Yoshii, Yokosuka city, Kanagawa Pref (35° 13' N, 139° 48' E). Site is Earliest Jomon period estimated from assoc Kayama-Joso type pottery. Coll by I Okamoto, Rikkyo Univ.

**N-1733. Matsumae** **3430 ± 140**  
**1480 BC**

Collagen of fossil bone from site at Era, Matsumae-cho, Hokkaido (41° 32' N, 140° 0' E). Site is Middle Jomon period estimated from assoc pottery. Coll by H Chiyo, Hakodate City Mus.

**N-1734. Sai** **3580 ± 125**  
**1630 BC**

Collagen of fossil bone from site at Sai-mura, Shimokita-gun, Aomori Pref (41° 25' N, 140° 52' E). Site is Middle Yayoi period estimated from assoc pottery. Coll by Y Iwamoto, Wakinosawa-mura Primary and Middle School.

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