

KAERI RADIOCARBON MEASUREMENTS III

CHAN KIRL PAK and KYUNG RIN YANG

Radioanalytical Division

Korea Atomic Energy Research Institute, Seoul, Korea

^{14}C dates listed in this report on geochemical, geologic, and archaeological samples were obtained mainly from the beginning of 1971 to the middle of 1973. Techniques of measurement used are the same as described previously (Yang, 1972). Sample descriptions and comments for archaeological samples were prepared in collaboration with collectors and submitters. For age calculation, 95% activity of NBS oxalic acid is used as the modern standard and the value of 5568 ± 40 years is used for the half-life of ^{14}C . Dates are expressed in years BP (before AD 1950). The error (1σ) quoted is calculated from the uncertainty involved in counting background, NBS oxalic acid standard, and sample.

ACKNOWLEDGMENTS

Atomic Energy Research Institute, Seoul, Korea which was operated by the central government was reorganized as a special juridical person, Korea Atomic Energy Research Institute, in February 1973. Our code designation, AERIK, was changed to KAERI, which will take over AERIK's running numbers. This work was supported by grants from KAERI and AERIK. We wish to thank the many individuals who supplied sample materials.

SAMPLE DESCRIPTIONS

I. GEOCHEMICAL SAMPLES

The following studies were made to confirm variations of ^{14}C concentration in the atmosphere due to ^{14}C from nuclear tests.

A. Atmospheric carbon dioxide series, Seoul, Korea

^{14}C content in surface air was measured from Feb 1970 to Aug 1971. Atmospheric CO_2 samples were coll on the roof of KAERI main building, Kongnung-dong, Songbuk-ku, Seoul, Korea ($37^\circ 38' \text{ N}$, $127^\circ 06' \text{ E}$) in a NE suburb of Seoul city. The site should be reasonably free from contamination of fossil CO_2 although smog from the city occasionally reaches the institute (Vogel, 1970). Samples coll by exposing 1.5L 0.5N NaOH in a 900 cm^2 tray for ca 5 days bimonthly. Results for 1970 were reported previously (Yang, 1972) and results for 1971 appear here.

Table 1
 ^{14}C content in surface air Seoul, Korea ($37^\circ 38' \text{ N}$) 1971

Sample no.	Date		$\delta^{14}\text{C}(\text{‰})^*$
KAERI-54	Jan	10-16	55.32
KAERI-55	Feb	10-15	41.84
KAERI-56	Feb	25-Mar 3	60.28

Sample no.	Date	$\delta^{14}\text{C}(\text{‰})^*$
KAERI-57	Mar 15-22	53.19
KAERI-58	Mar 25-31	61.72
KAERI-59	Apr 6-16	50.35
KAERI-60	Apr 26-May 3	63.10
KAERI-61	May 25-30	63.10
KAERI-62	June 25-30	58.16
KAERI-63	July 15-20	58.81
KAERI-64	July 26-30	58.16
KAERI-65	Aug 16-22	67.38
KAERI-66	Aug 25-29	57.45

* Above modern reference

Comment: no ^{13}C corrections applied, and apparently all samples coll here in winter and rainy season were contaminated by fossil carbon. From the results, we can estimate that during the above period the inventory of excess ^{14}C in the atmosphere decreased with a half-time of 4.6 yr, and over-all decrease by the year was also checked (Fairhall and Young, 1968).

B. Tree ring study

A *Larix Leptolepis*' Gordon grown at Kwang-nung, Kyunggi-do, Korea ($37^\circ 44' \text{ N}$, $127^\circ 12' \text{ E}$), with 37 growth rings, was assayed for ^{14}C content measurement. The rings were separated into 5-yr annual growth portions for the ^{14}C assay. For the radioactivity measurement, carbons in the wood were converted to carbons in benzene. The synthesized benzene was used as primary solvent of the liquid scintillation counting solution.

Table 2
Radiocarbon concentration in *Larix Leptolepis*'
Gordon tree rings, grown 1932-1968, ($37^\circ 38' \text{ N}$)

Sample no.	Age span	dpm/g C	$\delta^{14}\text{C}(\text{‰})$
KAERI-67	1932-1936	14.73 ± 1.0	41.7
KAERI-68	1937-1941	14.97 ± 1.0	58.7
KAERI-69	1942-1946	14.97 ± 1.0	58.7
KAERI-70	1947-1951	15.00 ± 1.0	60.8
KAERI-71	1952-1956	15.05 ± 1.0	64.4
KAERI-72	1957-1961	18.49 ± 1.0	307.6
KAERI-73	1962-1968	22.32 ± 1.1	578.5

Comment: tree ring study showed that the local atmosphere was affected by ^{14}C from nuclear tests after 1956.

II. ARCHAEOLOGIC SAMPLES

Wangjin-ri series

Samples from a kiln site in the NE river side of Kumgang, within 4km from upper stream of Paekmagang at Wangjin-ri, Cheongnam-myon, Cheongyang-kun, Chungcheongnam-do, Korea ($36^{\circ} 20' N$, $126^{\circ} 57' E$). The kiln sites were filled with river water in floods, but in dry weather the river water level lowers to 3m. It is believed the kiln sites probably provided tiles and vessels to dwellers of Puyo city, the last capital of Paekche dynasty. The structure was not the slope style at the base of kiln, but at the level one. Presumably, samples were from late 6th to 7th centuries, and were coll May 1971; subm by Chung Yang-mo, curator, Natl Mus Korea.

KAERI-74. Wangjin-ri, No. 1 **1330 \pm 70**
AD 620

Wood from black soil layer in bottom of Wangjin-kiln No. 4.

KAERI-75. Wangjin-ri, No. 2 **1660 \pm 70**
AD 290

Charcoal from black soil layer at bottom of Wangjin-kiln No. 4.

KAERI-76. Wangjin-ri, No. 3 **1400 \pm 70**
AD 550

Charcoal from bottom of 1st step fireplace of Wangjin-kiln No. 4.
Comment (C Y-m): KAERI-74 and -76 are the same period as our result, but KAERI-75 is earlier than ours.

KAERI-77. Tomb of King Munyong **1470 \pm 70**
AD 480

Wood from brick tomb of King Munyong who ruled Paekche dynasty AD 501 to 523. Tomb is at +50m, S side of river of Kumgang at Woongjin-dong, Kongju-eup, Kongju-gun, Chungcheongnam-do, Korea ($36^{\circ} 27' N$, $127^{\circ} 06' E$). Coll July 1971 and subm by Yun Mu-byong, Natl Mus Korea. *Comment* (Y M-b): date is earlier than stone epitaph from tomb.

KAERI-80. Daegok-ri **2560 \pm 120**
610 BC

Tomb from Bronze age, at Daegok-ri, Dogok-myon, Hwasun-gun, Cheollanam-do, Korea ($34^{\circ} 59' 50'' N$, $126^{\circ} 54' 50'' E$). Wood from coffin in tomb at 2m below surface. Coll Jan 1972 and subm by Han Byong-sam, Natl Mus Korea. *Comment* (H B-s): date is earlier than estimated.

KAERI-81. Yanggun-ri, YM-9 **2760 \pm 70**
810 BC

Charcoal from N bank of S tributary of Han R at Yanggun-ri, Yangp'yong-gun, Kyunggi-do, Korea ($37^{\circ} 29' N$, $127^{\circ} 29' E$), from Layer V, 81 to 104cm below surface. Site disclosed potsheards without surface design and some chipped stone implements. Coll 1972 and subm by Pow-

key Sohn, Yonsei Univ Mus, Seoul, Korea. *Comment* (P-k S): date seems slightly younger than expected possibly due to modern fungi grown after colln.

Kumejima series

Shell mound, at ca +12.5m at airport site, Kitaharu, Kumejima, Okinawa, Japan (26° 22' N, 126° 43' E) yielded a few Yayoi sherds of Sugu type, and a Chinese coin, tentatively identified as a K'ai Yung T'ang Pao. Shells are scattered through site, and are predominantly gastropods rather than bivalves. Kumejima lies ca 80km W of Naha, Okinawa, which is in inner volcanic zone of Ryuku chain (Pearson, 1969) and is composed of 2 high, superficially volcanic triangular areas joined by an alluvial lowland on E side. Coll Aug 1971 and subm Feb 1973 by R Pearson, Dept Anthropol & Sociol, Univ British Columbia, Vancouver 8, Canada.

1980 ± 100

KAERI-82. Airport shell mound, Bag 101 30 BC

Shell crust from excavation unit H-32, 50 to 60cm below surface of Layer III: burnt coral and shells, suggestive of living floor.

2700 ± 120

KAERI-83. Airport shell mound, Bag 708 750 BC

Shell crust from excavation unit H-30 and H-31, lower part of Layer III.

1190 ± 50

KAERI-84. Airport shell mound, Bag 72 AD 760

Shell crust from excavation unit G-36, 20 to 30cm from surface of Layer III. *Comment* (RP): KAERI-83 appears too old, from artifactual evidence. KAERI-82 and -84 seem very close to our estimate, since Layer III spans time of Sugu type Yayoi pottery of Kyushu to early T'ang dynasty, if identification of a Chinese coin as K'ai Yuan T'ung Pao is correct. KAERI-82 was from a large Tridacha shell at base of Layer III. Shell very possibly, was part of original beach matrix, or it may have been dead for a considerable time before being brought to living area.

Iriomote series

Shell mound, at ca +2m, at Funaura, Iriomote, Okinawa, Japan (24° 24' N, 128° 48' E). Through flotation of midden materials, mound yielded marine shells, dugong, pig bones, charred padanus keys, and several unidentified seeds. Ceramics were not found. Iriomote is the largest island in the Yaeyama group, 28,231 ha, with a population of only 4904. Coll Aug 1972 and subm Feb 1973 by R Pearson.

1130 ± 70

KAERI-85. Funaura shell mound, No. 1 AD 620

Shell crust from excavation Unit J-11, 50 to 60cm below top of Layer III.

KAERI-86. Funaura shell mound, No. 2 **1530 ± 70**
AD 420

Shell crust from excavation Unit J-11, 10 to 20cm below top of Layer IV.

KAERI-87. Funaura shell mound, No. 3 **1730 ± 70**
AD 220

Shell crust from excavation Unit J-11, 20 to 30cm below top of Layer III.

KAERI-88. Funaura shell mound, No. 4 **1400 ± 70**
AD 550

Shell crust from excavation Unit J-11, 0 to 10cm below top of Layer IV. *Comment* (RP): if we use KAERI-85 for Layer III and overlap of 2 dates for Layer IV, dates seem to fall into a smooth sequence compared to a date for Layer II, previously reported: Y-1697, AD 1010 (Stuiver, 1969), Layer III produced several small fragments of iron apparently traded with occupants of site.

KAERI-91. Sangjapo-ri **2170 ± 60**
220 BC

Charcoal from a dolmen in layer near South Han R, 100m from water line, at Sangjapo-ri, Kaegun-myon, Yangp'yong-gun, Kyunggi-do, Korea (37° 25' N, 127° 35' E). Sample was with pieces of human bone from a stone coffin placed in accumulated stone layer of underground construction of the dolmen (S style). Coll Sept 1972 and subm March 1973 by Suk Kyung Choi, Yiwha Womens Univ, Seoul, Korea. *Comment* (S-k C): seems relevant.

KAERI-93. Chongwangyi-ri, YM-10 **2530 ± 120**
580 BC

Peat from Layer II, 25 to 68cm below surface under rice paddy near W coastline. Site was originally tide-driven area before rice paddy was made at Chongwangyi-ri, Kunja-myon, Sihung-gun, Kyunggi-do, Korea (37° 21' N, 126° 45' E). Coll Feb 1973 and subm by Pow-key S. *Comment* (P-k S): seems relevant.

KAERI-94. Sogun-ri, YM-11 **690 ± 50**
AD 1260

Charcoal from slightly disturbed upper sand layer of a shell midden with chipped stone implements and potsherds without surface designs. Shells are *Gastropoda ocenebra japonica*, *Pelecypoda mytilus corscus*, *Saxostrea echinata*, *Grossostrea gigas*, *Prothothace euglypta*. Midden is 10m above present sea level at Maktong Purak, Sogun-ri, Sowon-myon, Sosan-gun, Chungcheongnam-do, Korea (36° 48' N, 126° 09' E). Coll Mar 1973 and subm by Pow-key Sohn. *Comment* (P-k S): charcoal might have been recent mixed into layer by later disturbance as area has long been used for swimming and picnic.

3900 ± 200**1950 BC****KAERI-95. Yangsu-ri**

Charcoal from a dolmen at Yangsu-ri, Yangsu-myon, Yangp'yong-gun, Kyunggi-do, Korea (37° 32' 18" N, 127° 18' E). Charcoal was in area of 220 x 270cm at 15cm under table stone. Site is a wide sand zone at meeting point of South and North Han R, and many Prehistoric age implements were found. Coll Aug 1972 by excavation team of Bureau of Preservation of Cultural Property, Korea and subm Jan 1973. *Comment* (BPCP): date seems too old.

720 ± 100**AD 1230****KAERI-97. Dunma-ri**

Charcoal from a stone cist tomb at Dunma-ri, Namha-myon, Keochang-gun, Kyungsangnam-do, Korea (35° 44' 02" N, 127° 58' E), from coffin supporter, 101 to 110cm under mound surface. Coll and subm Dec 1972 by BPCP, Korea. *Comment* (BPCP): date seems reliable.

1630 ± 70**AD 320****KAERI-98. Tomb#155, No. 730713**

Wood from tomb of Silla dynasty at Hwangnam-dong, Keongju-si, Keongsangpuk-do, Korea (35° 50' 19" N, 129° 12' 50" E). Site has many huge tombs of Silla dynasty. Sample is part of wooden coffin from layer of old implements including golden crown. Coll July 1973 and subm by BPCP, Korea. *Comment* (BPCP): problems caused by old tree must be considered.

REFERENCES

- Fairhall, A W and Young, J A, 1968, Radiocarbon in the environment: Washington Univ, Seattle, RLO-2091-2, 21 p.
- Pearson, R J, 1969, The archaeology of the Ryuku Islands; a regional chronology from 3000 BC to Historic times: Honolulu, Univ Hawaii Press.
- Stuiver, M, 1969, Yale natural radiocarbon measurements IX: Radiocarbon, v 11, p 345-658.
- Vogel, J C, 1970, Groningen radiocarbon dates IX: Radiocarbon, v 12, p 444-471.
- Yang, K R, 1972, Atomic Energy Research Institute of Korea radiocarbon measurements II: Radiocarbon, v 14, p 273-279.

KAERI-95. Yangsu-ri **3900 ± 200**
1950 BC

Charcoal from a dolmen at Yangsu-ri, Yangsu-myon, Yangp'yong-gun, Kyunggi-do, Korea (37° 32' 18" N, 127° 18' E). Charcoal was in area of 220 x 270cm at 15cm under table stone. Site is a wide sand zone at meeting point of South and North Han R, and many Prehistoric age implements were found. Coll Aug 1972 by excavation team of Bureau of Preservation of Cultural Property, Korea and subm Jan 1973. *Comment* (BPCP): date seems too old.

KAERI-97. Dunma-ri **720 ± 100**
AD 1230

Charcoal from a stone cist tomb at Dunma-ri, Namha-myon, Keochang-gun, Kyungsangnam-do, Korea (35° 44' 02" N, 127° 58' E), from coffin supporter, 101 to 110cm under mound surface. Coll and subm Dec 1972 by BPCP, Korea. *Comment* (BPCP): date seems reliable.

KAERI-98. Tomb#155, No. 730713 **1630 ± 70**
AD 320

Wood from tomb of Silla dynasty at Hwangnam-dong, Keongju-si, Keongsangpuk-do, Korea (35° 50' 19" N, 129° 12' 50" E). Site has many huge tombs of Silla dynasty. Sample is part of wooden coffin from layer of old implements including golden crown. Coll July 1973 and subm by BPCP, Korea. *Comment* (BPCP): problems caused by old tree must be considered.

REFERENCES

- Fairhall, A W and Young, J A, 1968, Radiocarbon in the environment: Washington Univ, Seattle, RLO-2091-2, 21 p.
 Pearson, R J, 1969, The archaeology of the Ryuku Islands; a regional chronology from 3000 BC to Historic times: Honolulu, Univ Hawaii Press.
 Stuiver, M, 1969, Yale natural radiocarbon measurements IX: Radiocarbon, v 11, p 345-658.
 Vogel, J C, 1970, Groningen radiocarbon dates IX: Radiocarbon, v 12, p 444-471.
 Yang, K R, 1972, Atomic Energy Research Institute of Korea radiocarbon measurements II: Radiocarbon, v 14, p 273-279.