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NATIONAL TAIWAN UNIVERSITY RADIOCARBON MEASUREMENTS I

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Natural C^{14} measurements have been performed at the Dept. of Physics, National Taiwan University since 1965, using a cylindrical proportional counter of 1000 ml (Hsu *et al.*, 1965). The proportional counter is operated with CO_2 as the filling gas at a pressure of 1216 mm Hg at room temperature of 20°C. Working voltage is 4.7 Kv, with a plateau length of more than 700 v and a plateau slope of ca. 1% per 100 v. Background is reduced to 5.1 counts/min and the counting rate of the NBS oxalic acid standard is 9.4 counts/min at the normal counting pressure of 1216 mm Hg.

The counter, which is shielded by iron plates of 25 cm thickness and by anti-coincidence with a multianode propane-flow proportional counter of Houtermans' type (Houtermans and Oeschger, 1955), is connected by copper tubing to a pumping system (rotary and diffusion pump with liquid air trap). The vacuum inside the counter is better than 10^{-5} mm Hg.

Samples are first examined under a binocular to pick up as many rootlets as possible and to remove foreign matters. They are then treated with 2% NaOH and 2% HCl. After being rinsed with distilled water and dried, they are burnt in a stream of oxygen. The released CO_2 is passed through hot CuO and absorbed in aqueous ammonia. Then it is precipitated as calcium carbonate after calcium chloride solution is added. After washing with hot distilled water and drying, the pure calcium carbonate is placed in a quartz tube which is kept at a temperature of 400°C and evacuated for more than five hours. The carbon dioxide is liberated by raising the temperature to 800°C and passed through dry-ice trap, frozen out by a serial of liquid air traps, purified by pumping off gaseous impurities between displacement from one trap to another in a solid state with a diffusion pump and finally evaporated into the counter.

Every sample is counted for at least 48 hours. Background determinations have been based on CO_2 obtained from marble. All ages are calculated using as "living" standard 0.95 of the activity measured on NBS oxalic acid and 5570 yr for the half-life of C^{14}, 1950 being the reference year. Errors quoted include the standard deviations of the count rates for the unknown sample, the contemporary standard, and the background.

In this article, results obtained for geologic, archaeologic, and geophysical samples are described. The description of each sample is based on information provided by the person submitting the sample to the laboratory.

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SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

A. China

NTU-68. Chinmun Island **4690 ± 280**
2740 B.C.

Peat from +30 m, at 0.5 m depth, in farm of Houlong, Chinmun I., Fukien prov., China (24° 24′ N Lat, 116° 25′ E Long). Coll. 1958 by Fu-Yin Lin and subm. 1969 by Pei-Yuan Chen, Dept. of Geol., Natl. Taiwan Univ. *Comment* (P.Y.C.): sample is from peat deposit of Quaternary age from Chinmun I. (Lin, 1958). According to present data, deposit should be from middle Holocene time.

B. Malaysia

NTU-73. Malaysia **>27,000**

Driftwood found at ca. +100 m, 20 m deep, at Ipoh, Perak, Malaysia (04° 34′ N Lat, 101° 06′ E Long). Coll. 1968 and subm. 1969 by Y. Wang, Dept. of Geol., Natl. Taiwan Univ. *Comment* (Y.W.): date is appropriate provided that this part of Malay Peninsula has been subjected to long-term erosion (Ingham and Bradford, 1960) and recent rate of deposition has been very slow.

II. ARCHAEOLOGIC SAMPLES

China

Hsi-hsin-chuang-tze series

Shell (*corbicula* subsulcata) found from Early Iron age shell mound at Hsi-hsin-chuang-tze, Taipei, Taiwan, China (25° 04′ N Lat, 121° 31′ E Long), at +5 m. Coll. 1967 and subm. 1968 by W. H. Sung, Dept. of Archaeol. and Anthropol., Natl. Taiwan Univ.

NTU-52. Hsi-hsin-chuang-tze 1 **1940 ± 190**
A.D. 10

Ca. 1.1 m depth.

NTU-53. Hsi-hsin-chuang-tze 2 **2390 ± 200**
440 B.C.

Ca. 0.7 m depth.

NTU-54. Hsi-hsin-chuang-tze 3 **2010 ± 200**
60 B.C.

Ca. 0.3 m depth. *Comment* (W.H.S.): dates seem to agree with estimates based on cultural materials which may compare in part with the Shih-san-hang site (Sung, 1965), 1444 ± 204 and 1145 ± 206 (NTU-7 and NTU-8, Hsu and Huang, 1965) and the Fan-tze-yuan site 1500 ± 80; Y-1499 (Sung, 1965).

3060 ± 280
NTU-55. Chishivayan, Ch'i-lin **1110 B.C.**

Charcoal from Megalithic site at Chishivayan, Ch'i-lin, Taitung, Taiwan (23° 06′ N Lat, 121° 21′ E Long), at +80 m, 0.8 m depth. Coll. and subm. 1968 by W. H. Sung. *Comment* (W.H.S.): date seems to agree with estimates based on cultural material.

General Comment (W.H.S.): NTU-52, NTU-53, NTU-54, and NTU-55 were all closely connected with floor level of megalithic feature at T1P4 pit (Sung, 1969).

Tung-chiao series

Charcoal fragments in sandy soil, at +300 m, at Tung-chiao, Chi-chi, Nan-t'ou Hsien, Taiwan (23° 45′ N Lat, 120° 47′ E Long). Coll. and subm. 1968 by Judith M. Treistman, Dept. of Archaeol. and Anthropol., Natl. Taiwan Univ.

1630 ± 160
NTU-56. Tung-chiao 1 **A.D. 320**

From ca. 0.68 m depth. *Comment* (J.M.T.): appears younger than expected. Cultural materials may compare in part with Yin P'u site (Huang, 1968), which has C^{14} dates ranging between 2970 ± 80 (Y-1630, Sung, 1965) to 2250 ± 60; Y-1632 (Sung, 1965).

3840 ± 380
NTU-57. Tung-chiao 2 **1890 B.C.**

From ca. 0.5 m depth. *Comment* (J.M.T.): age seems to agree with estimates based on cultural material.

Fukuotun series, Chinmun Island

Shell mound consists of abundant shells, including some blackish and brownish pottery fragments, with or without sculptured patterns. Coll. 1968 by C. C. Lin, Dept. of Geol., Natl. Taiwan Univ., at Chinmun I., Fuchien prov., China (24° 40′ N Lat, 118° 30′ E Long), at ca. +40 m. *Comment* (C.C.L.): thickness of shell mound is ca. 70 cm and the only archaeol. site ever found on the Island.

5460 ± 320
NTU-63. Fukuotun 1 **3510 B.C.**

Shell samples from 10 to 20 cm depth.

5800 ± 340
NTU-64. Fukuotun 2 **3850 B.C.**

Shells from 40 to 50 cm depth.

6310 ± 370
NTU-65. Fukuotun 3 **4360 B.C.**

Shells from 70 to 80 cm depth.

Chang-pin series

Charcoal from LHII (Sung, 1969) Cave, Chang-pin, Taitung, Taiwan (23° 24′ N Lat, 121° 25′ E Long), at +40 m. Coll. and subm. 1969 by W. H. Sung.

5240 ± 260
NTU-69. Chang-pin 1 **3290 B.C.**

From ca. 1.22 m depth from preceramic cultural layer at T4P2NE pit.

5340 ± 260
NTU-70. Chang-pin 2 **3390 B.C.**

From ca. 1.03 m depth from preceramic cultural layer at T3P1S pit.

4970 ± 250
NTU-71. Chang-pin 3 **3020 B.C.**

From ca. 0.75 to 0.85 m depth from preceramic cultural layer of T3P2S pit. *Comment* (W.H.S.): NTU-69, NTU-70, and NTU-71 samples appear younger than expected. Cultural materials may compare in part with those from Tabon Cave, Palawan, Philippines, which have C^{14} dates ranging between 7,000 to 30,000 yr ago (Fox, n.d. and 1968).

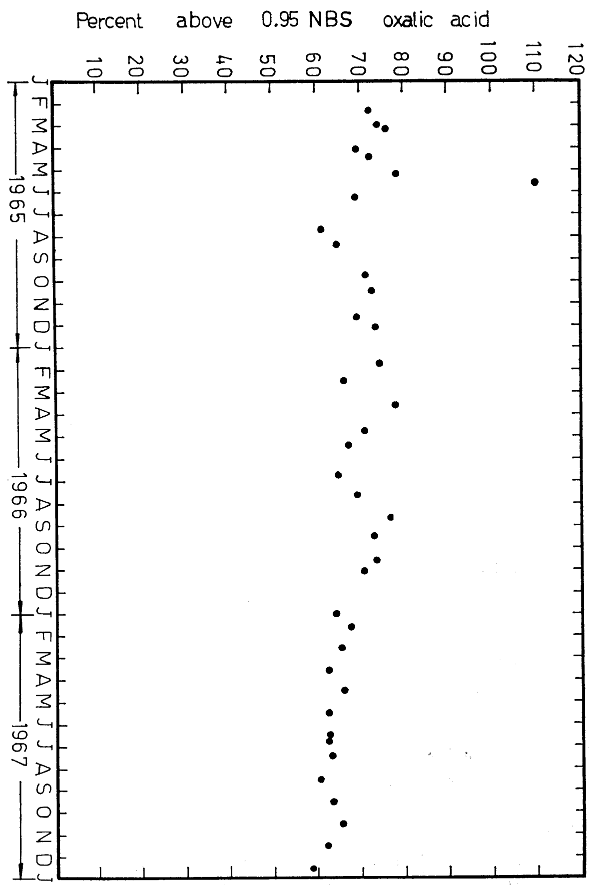

Fig. 1. C^{14} enrichment over NBS standard of atmospheric CO_2 during 1965 to 1967 at Taipei, Taiwan (25° 02′ N Lat, 121° 31′ E Long).

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General Comment (W.H.S.): younger dates of samples might be caused by inherent contamination.

III. GEOPHYSICAL SAMPLES

C^{14} in Atmospheric Carbon Dioxide

Atmospheric Radiocarbon Activity series, Taipei

C^{14} content in ground level atmospheric CO_2 is monitored monthly at Taipei, Taiwan (25° 02′ N Lat, 121° 31′ E Long).

The following list contains exposure time of NaOH solutions to air and per cent increase of δC^{14} above 95% NBS oxalic acid. Data are graphed in Fig. 1. The statistical error is less than 1%. *Comment* (authors): the unusually high value of NTU-80 for collection period 19 May–25 May 1965 may be due to the nuclear test in the mainland of China on 13 May 1965.

Sample no.	Exposure time	δC^{14}, %
NTU-74	11 Feb. 1965	+72.2
NTU-75	1 Mar. 1965	+74.1
NTU-76	2 Mar. – 8 Mar. 1965	+76.4
NTU-77	2 Apr. 1965	+69.5
NTU-78	12 Apr. 1965	+72.4
NTU-79	3 May – 18 May 1965	+78.4
NTU-80	19 May – 25 May 1965	+110.1
NTU-81	8 June 1965	+69.0
NTU-82	21 July 1965	+61.3
NTU-83	13 Aug. 1965	+64.7
NTU-84	22 Sept. 1965	+71.2
NTU-85	14 Oct. 1965	+72.6
NTU-86	20 Nov. 1965	+69.2
NTU-87	3 Dec. – 20 Dec. 1965	+73.4
NTU-88	26 Jan. – 31 Jan. 1966	+74.5
NTU-89	16 Feb. – 28 Feb. 1966	+66.0
NTU-90	19 Mar. – 27 Mar. 1966	+77.6
NTU-91	25 Apr. – 30 Apr. 1966	+70.9
NTU-92	11 May – 18 May 1966	+67.2
NTU-93	22 June – 30 June 1966	+64.7
NTU-94	20 July – 29 July 1966	+69.0
NTU-95	20 Aug. – 25 Aug. 1966	+76.6
NTU-96	15 Sept. – 25 Sept. 1966	+72.8
NTU-97	18 Oct. – 27 Oct. 1966	+73.1
NTU-98	2 Nov. – 12 Nov. 1966	+70.4
NTU-99	30 Dec. – 5 Jan. 1967	+64.0
NTU-100	17 Jan. – 22 Jan. 1967	+67.5
NTU-101	16 Feb. – 22 Feb. 1967	+65.1
NTU-102	18 Mar. – 21 Mar. 1967	+62.2
NTU-103	15 Apr. – 20 Apr. 1967	+65.9

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Sample no.	Exposure time	δC^{14}, %
NTU-104	15 May – 17 May 1967	+62.2
NTU-105	15 June – 20 June 1967	+62.3
NTU-106	22 June – 27 June 1967	+62.1
NTU-107	15 July – 22 July 1967	+62.8
NTU-108	15 Aug. – 20 Aug. 1967	+60.3
NTU-109	16 Sept. – 21 Sept. 1967	+63.2
NTU-110	15 Oct. – 20 Oct. 1967	+65.1
NTU-111	15 Nov. – 20 Nov. 1967	+61.8
NTU-112	16 Dec. – 21 Dec. 1967	+58.5

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