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SYDNEY UNIVERSITY NATURAL RADIOCARBON MEASUREMENTS I

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Preparations to establish a radiocarbon dating laboratory at the University of Sydney were made in 1970 in the Department of Physical Chemistry, to support Ph.D. studies and to supplement existing dating services in Australia to the archaeologic and geologic communities.

Liquid scintillation counting is used, with benzene synthesized by the method of Polach and Stipp (1967) as the counting liquid. Four ml benzene is mixed with 1 ml AR toluene containing PPO and dimethyl POPOP to give final scintillant concentrations of 0.4 g/l and 0.05 g/l respectively (Tamers, 1965). Initially, a Philips scintillation spectrometer was used in the Pathology Department, University of Sydney. A single 20 ml vial was employed alternating 1 to 3 day sample, background and modern standard determinations.

Recently the department acquired a Packard Model 2211 scintillation spectrometer, now set up specifically for natural radiocarbon measurements following the optimization, balance point, 5 ml vial design and cycling procedures established at the ANU laboratory (Polach, 1969). Background count rate B for 5 ml vials is ca. 4.1 cpm and net oxalic acid standard count rate is ca. 31.1 cpm. Thus, the very favorable figure of merit $N^2/B = 236$ (N = net 0.95 NBS oxalic) and $E^2/B = 1480$ (counting efficiency E being ca. 78%) is obtained.

Because C^{13}/C^{12} ratios were not measured, best available estimates of their group mean values are based on carbon isotope distribution in nature as first established by Craig (1954). The estimated δC^{13} values used are listed and the δC^{13} corrected δC^{14} values, Δ, are reported as parts per mil (‰) observed deviation from 0.95 NBS oxalic acid standard (cf. Radiocarbon, editorial statement; Polach, 1969).

A series of previously dated samples has been run to check our preparation and counting technique (see Table 1a). For oxalic preparations, we used the wet $KMnO_4$ oxidation method and compared our observed count rate with that obtained by the radiocarbon laboratories at the University of NSW and ANU, using the ANU Sucrose Standard as reference material. The agreement of all values (see Table 1b) indicates that very limited fractionation has occurred during our oxalic preparations and validates our results.

All ages are calculated using the Libby half-life of 5570 ± 30 years and 0.95 NBS oxalic modern standard with A.D. 1950 as refreence year. Errors quoted are one standard deviation based on counting statistics only. Thus the errors for samples counted on the Philips spectrometer

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(SUA-1, 6-9, 11, 12) are larger than those counted on the Packard (SUA-13-18, MSO1, MSO2).

Sample pretreatment, unless otherwise specified, consists of careful visual inspection followed by dilute HCl and distilled water washings. If sufficient CO_2 is not produced in a combustion or acid hydrolysis, the sample gas is diluted with cylinder CO_2 of known activity. Such dilutions are indicated in the text.

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SAMPLE DESCRIPTIONS

I. CHECK SAMPLES

Table 1a

Interlaboratory check samples

SUA no.	SUA date	Other lab. no.	Other date	Reference
SUA-1	4780 ± 230	Gak-834	4220 ± 100	Langford-Smith, coll., pers. commun.
SUA-6	1400 ± 100	ANU-446	1490 ± 80	Polach, pers. commun.
SUA-7	27,030 ± 2250	ANU-227	22,250 ± 500	Polach *et al.* (1970)
SUA-8	1540 ± 100	ANU-207	1760 ± 80	Polach, pers. commun.
SUA-9	2030 ± 115	ANU-263A	2160 ± 110	Polach *et al.* (1970)
SUA-13	1150 ± 80	ANU-538/1	980 ± 70	Polach, pers. commun.
		ANU-538/2	1025 ± 70	Polach, pers. commun.
		Gak-770	730 ± 90	Taylor, collector, pers. commun.
		NSW-59	1040 ± 60	Carswell, pers. commun.
SUA-14	24,290 ± 400	ANU-918	23,290 ± 560	Polach, pers. commun.

Table 1a (continued)

SUA no.	SUA date	Other lab. no.	Other date	Reference
		Gak-3438	21,400 ± 250	Langford-Smith, coll., pers. commun.
		NSW-60	25,800 ± 900	Carswell, pers. commun.

Comment: age determination cross checks between Australian labs were done on correctly proportioned batches of same sample pretreated by H.A.P.; Gak-770 and -3438 were done on another part of "same sample"; age differences are probably due to this factor or to different pretreatments. Otherwise there is excellent agreement between all labs.

Table 1b

ANU Sucrose Standard (uncorrected for δC^{13}) w.r.t. 0.95 NBS oxalic (corrected for δC^{13}) expressed as % Modern.

SUA no.	SUA date	Other lab no.	Other date	Reference
SUA-MS01	152.3 ± 1.0	ANU-MS03	156.2 ± 1.0	Polach, pers. commun.
SUA-MS02	154.6 ± 1.0	ANU-MS04	157.5 ± 1.0	Polach, pers. commun.
		ANU-MS05	155.1 ± 1.0	Polach, pers. commun.
		NSW-MS01	152.8 ± 1.0	Carswell, pers. commun.

Comment: each independent determination of the activity of Sucrose is based on a 3000 min. count with excellent agreement around a mean value of 154.75 ± 1% Modern.

II. GEOLOGIC SAMPLES

SUA-11. Wollombi **1820 ± 190**
A.D. 130

$\Delta = -203 \pm 19.0$ *Est.* $\delta C^{13} = -24.0 \pm 2.0‰$

Wood charcoal from alluvial sediments of silt-clay in a tributary valley of Wollombi Brook, near Wollombi, N.S.W. (32° 53′ S Lat, 151° 08′ E Long) exposed in a cut bank 2.5 m above present stream level. Coll. 1971 by K. J. Page, Geog. Dept., Univ. Sydney, as part of a series on chronology of tributary valley alluvial fills. Other samples in series have departmental code nos. 69/C/16, 70/C/10 and 70/C/11; 69/C/16 dated at 4280 ± 120 B.P. (Kigoshi, pers. commun.).

SUA-12. Kempsey **3010 ± 240**
1060 B.C.

$\Delta = -312.1 \pm 9.7$ *Est.* $\delta C^{13} = -2.0 \pm 2.0‰$

Marine shells from top of spoil removed in construction of drainage

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ditch at Hat Head, near Kempsey, N.S.W. Sample and assoc. sediments suggest existence of sandy estuarine silt ca. 10 m below present surface. Coll. 1971 by B. Thom, Dept. Biogeog. and Geomorphol., A.N.U. (Dilution, 1000 min. count.) *Comment* (B.T.): indicates Recent age sediment transgresser by dunes, not related to Inner Barrier system.

III. ARCHAEOLOGIC SAMPLES

Blue Mountains series

Charcoal coll. 1971 by W. N. Holland and E. D. Stockton; subm. by Geog. Dept., Univ. Sydney. Dates are part of study on aboriginal occupation and climate in Blue Mountains area of N.S.W.

SUA-15. Leura **12,550 ± 144**
10,600 B.C.

$\Delta = -790.4 \pm 3.7$ *Est.* $\delta C^{13} = -24.0 \pm 2.0‰$

Charcoal from Layer 9 to 18 cm below surface of cave at Lyre Bird's Dell, near Leura, N.S.W. (33° 43′ 30″ S Lat, 150° 20′ E Long). Assoc. with Capertian phase artifacts. (1300 min. count.)

SUA-16. Hazelbrook **7280 ± 230**
5330 B.C.

$\Delta = -596.0 \pm 11.3$ *Est.* $\delta C^{13} = -24.0 \pm 2.0‰$

Charcoal embedded in terrace alluvium 30 to 60 cm below surface of cave at Horseshoe Falls, near Hazelbrook, N.S.W. (33° 42′ 40″ S Lat, 150° 27′ 30″ E Long). Assoc. with Capertian phase artifacts. (Dilution, 1120 min. count.)

SUA-17. Springwood **2930 ± 165**
980 B.C.

$\Delta = -305.5 \pm 13.9$ *Est.* $\delta C^{13} = -24.0 \pm 2.0‰$

Charcoal embedded in colluvium 46 cm below surface of cave adjacent to Springwood Creek, near Springwood, N.S.W. (33° 40′ 20″ S Lat, 150° 35′ E Long). Assoc. with Bondaian phase artifacts. This level, underlain by a sterile zone, marks basal limit of Bondaian culture (cf. SUA-18). (Dilution, 1040 min. count.)

SUA-18. Springwood **6050 ± 170**
4100 B.C.

$\Delta = -529.3 \pm 9.7$ *Est.* $\delta C^{13} = -24.0 \pm 2.0‰$

Charcoal embedded in colluvium 76 cm below surface of cave adjacent to Springwood Creek, near Springwood, N.S.W. (33° 40′ 20″ S Lat, 150° 35′ E Long). Assoc. with Capertian phase artifacts. This level, overlain by a sterile zone, marks upper limit of Capertian culture (cf. SUA-17). (Dilution, 1040 min. count.)

General Comment (W.N.H.): these dates, with others from same area (Stockton and Holland, ms. in preparation) suggest a break in occupation between Bondaian and Capertian phases thought to be assoc. with a coincidental deterioration of climatic conditions in this area.

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