

GAKUSHUIN NATURAL RADIOCARBON MEASUREMENTS V

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This list includes many of the datings done from September 1964 to October 1965. The instruments and techniques used for this work are essentially the same as those used previously (Gakushuin III). Bone samples were dated on the organic materials obtained by the following procedure. After washing with distilled water the powdered bone samples were boiled with 10% H_2SO_4 solution 10 to 40 hours. The extract, a clear solution, was evaporated to almost dryness, and, after concentrated H_2SO_4 was added, heating was continued until most of the organic compounds became insoluble carbonized or polymerized material. The black residue was washed in water and treated as the usual charcoal sample for dating.

Age calculations are based on the Libby half life of C^{14} , 5570 ± 30 yr, and the modern activity given by $0.95A_{\text{ox}}$, i.e., 95% of the activity of NBS oxalic-acid standard. Except for tree ring samples, the errors quoted are the standard deviation obtained from the number of counts only. When observed activities are less than 2σ above background, infinite dates are given with a limit corresponding to the activity of 3σ , and when they are greater than $0.95A_{\text{ox}} - 2\sigma$, modern dates are given with the limit equal to $0.95A_{\text{ox}} - 3\sigma$.

We wish to acknowledge the help of Tamako Morinaga in preparing chemical samples. The description and comments are essentially those of persons submitting the samples.

SAMPLE DESCRIPTIONS

I. TREE RING SAMPLES

Tree ring dated samples were taken from a tree trunk of *Cryptomeria japonica* from Yalu Island, Kyushu ($30^\circ 40'$ N Lat, $130^\circ 30'$ E Long). Each annual tree ring was separated and the tree rings of 20- or 10-year sequences were mixed to make a sample for the assay of C^{14} .

Activity measurements were made on ca. 7 L of acetylene under 1 atm pressure. The results of assay are shown in Table 1 together with the values of δC^{13} which were measured by H. Sakai of Okayama Univ. on seven randomly selected samples. The calculation of Δ° for all samples except these seven was made under the assumption that δC^{13} is equal to a mean value indicated in Table 1. The errors of Δ° listed are standard deviations including statistical errors calculated from counting number, errors derived from applied high voltage, and errors derived from the estimation of δC^{13} .

The secular variation of the atmospheric C^{14} concentration suggested by these measurements was discussed by Kigoshi and Hasegawa

TABLE 1
Radiocarbon Concentration in Yaku Sugi Tree Rings

Code no.	Age span A.D.	$\delta^{14}\text{C}/\text{‰}$ Decay was corrected by half life of C^{14} , 5570 yr.	$\delta^{13}\text{C}/\text{‰}$ $\delta^{13}\text{C}$ of NBS oxalic acid standard was assumed to be -18.6 ‰ .	$\Delta \text{‰}$
GaK-270:27.	137 to 156	-14.9 ± 2.9		-17.7 ± 3.1
GaK-270:9.	167 to 186	-13.0 ± 3.0		-15.8 ± 3.2
GaK-270:26.	167 to 186	-14.4 ± 3.3		-17.2 ± 3.4
GaK-270:28.	187 to 196	-11.6 ± 3.1	-23.6 ± 0.2	-14.4 ± 3.1
GaK-270:29.	227 to 236	-18.6 ± 2.9		-21.4 ± 2.9
GaK-270:30.	317 to 326	-9.3 ± 3.1		-12.2 ± 3.2
GaK-270:12.	387 to 406	-5.9 ± 3.0		-8.7 ± 3.2
GaK-270:13.	467 to 486	-8.9 ± 3.4		-11.7 ± 3.5
GaK-270:22.	467 to 486	-6.6 ± 3.4		-9.4 ± 3.5
GaK-270:14.	587 to 606	-11.2 ± 3.2		-14.0 ± 3.3
GaK-270:15.	667 to 686	-17.4 ± 3.3	-23.1 ± 0.2	-21.2 ± 3.3
GaK-270:21.	667 to 686	-14.4 ± 3.0		-17.2 ± 3.2
GaK-270:1.	707 to 726	$+2.5 \pm 3.5$		-0.2 ± 3.6
GaK-270:20.	787 to 806	-7.4 ± 2.9	-22.9 ± 0.2	-11.6 ± 2.9
GaK-270:2.	807 to 826	-9.1 ± 2.9		-11.9 ± 3.1
GaK-270:19.	887 to 906	-10.5 ± 2.9	-24.3 ± 0.2	-11.9 ± 2.9
GaK-270:8.	927 to 946	-6.4 ± 2.9		-9.2 ± 3.1
GaK-270:16.	947 to 966	-11.1 ± 2.9		-13.9 ± 3.1
GaK-270:3.	1047 to 1066	-6.5 ± 3.7		-9.3 ± 3.8
GaK-270:4.	1127 to 1146	-5.4 ± 3.5		-8.2 ± 3.6
GaK-270:5.	1207 to 1226	-5.2 ± 3.1		-8.0 ± 3.2
GaK-270:6.	1327 to 1346	-6.2 ± 3.2		-9.0 ± 3.3
GaK-270:25.	1347 to 1366	-4.6 ± 2.9		-7.4 ± 3.1
GaK-270:7.	1447 to 1466	-1.8 ± 3.2		-4.6 ± 3.3
GaK-270:23.	1507 to 1526	-2.9 ± 2.8	-24.1 ± 0.2	-4.7 ± 2.8
GaK-270:24.	1587 to 1606	$+10.5 \pm 2.9$	-24.3 ± 0.2	$+9.1 \pm 2.9$
GaK-270:10.	1647 to 1666	$+7.3 \pm 3.6$		$+4.5 \pm 3.7$
GaK-270:17.	1667 to 1686	$+4.4 \pm 2.7$		$+1.6 \pm 2.9$
GaK-270:18.	1687 to 1706	-4.5 ± 2.7	-22.8 ± 0.2	-7.3 ± 2.9
GaK-270:11.	1847 to 1866	-7.1 ± 2.8		-9.9 ± 3.0
Mean value of $\delta^{13}\text{C} = -23.6 \pm 0.5$				

(1966) in relation to paleomagnetic data. The curves shown in Figure 1 are the computed variation in the atmospheric C^{14} concentration under an assumed variation of the magnitude of geomagnetic dipole moment which was given by Nagata (private commun.) as an average of observed magnitude of equatorial geomagnetic force in ancient time. Curves 1 and 2 give the limits of probable variation of computed values which are also affected by an unknown factor, i.e., the variation in geomagnetic dipole moment more than several thousand years ago. *Comment:* part of results of this series was published in Gakushuin III (1964). Those results were recalculated and listed in Table 1.

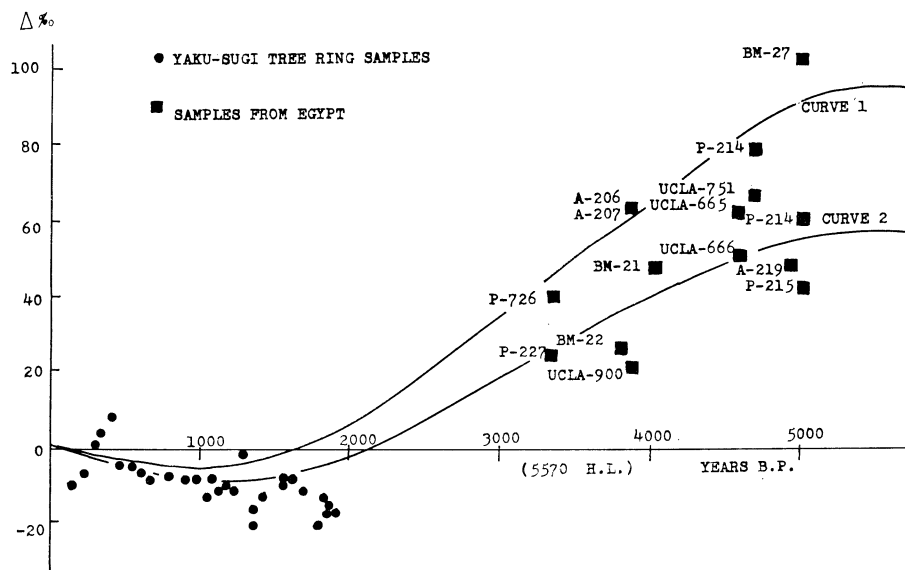


Fig. 1. Computed variations in atmospheric C^{14} concentration based on the variation in geomagnetic dipole moment and observed C^{14} content in Yaku-sugi tree ring samples (Table I) and in wood samples from Egypt measured by Ralph (Pennsylvania III), Stuckenrath and Ralph (Pennsylvania VIII), Fergusson and Libby (UCLA I), Berger, Fergusson, and Libby (UCLA IV), Barker and Mackey (British Museum I), Damon and Long (Arizona III), and Damon, Long, and Sigalove (Arizona IV).

II. GEOLOGIC SAMPLES

A. Japan

Ata and Aira pyroclastic flow deposits series, Kyushu

Samples from pyroclastic flow deposits in southern part of Kyushu Island related to volcanic eruptions of large-scale pyroclastic flows which resulted in formation of Ata and Aira calderas.

GaK-472. Kukino, Kagoshima

24,500 ± 900
22,550 B.C.

Carbonized wood from road cut ca. 1 km S of Kukino, Kaseda City, Kagoshima Prefecture ($31^{\circ} 19' 21''$ N Lat, $130^{\circ} 16' 38''$ E Long), alt 70 m, in lower part of Ata pyroclastic flow deposit, 10 cm above basement of deposit. Coll. and subm. 1964 by Tadahide Ui and Shigeo Aramaki, Univ. of Tokyo. *Comment* (S.A.): dates formation of Ata Caldera and confirms known stratigraphic order of Osumi pumice fall deposit dated as $22,000 \pm 850$ B.P. GaK-211 Gakushuin II) and Ito pyroclastic flow deposit. For tephrochronology of this area, see Gohara (1963).

GaK-469. Nojiri, Miyazaki

27,700 ± 1500
25,750 B.C.

Charcoal from boring at Kakenbifu, Nojiri-machi, Miyazaki Prefecture ($31^{\circ} 56' 45''$ N Lat, $131^{\circ} 9' 0''$ E Long), 70.5 m from surface, im-

bedded in clay just below thick pyroclastic flow deposit. Coll. and subm. 1964 by Hisashi Asada, Chuō Kaihatsu. *Comment*: dates maximum age of Shinkawa (?) pyroclastic flow deposit.

16,350 ± 350
14,400 B.C.

GaK-473. Ichihino, Kagoshima

Carbonized wood from campus of Ichihino Junior High School, Hiwaki-machi, Kagoshima Prefecture (31° 47' 21" N Lat, 130° 24' 18" E Long), in Ito pyroclastic flow deposit. Coll. and subm. by Aramaki. *Comment* (S.A.): dates formation of Aira Caldera which is probably just after the deposition of Ito pyroclastic flow. See GaK-211 (Gakushuin II).

23,400 ± 800
21,450 B.C.

GaK-558. Ushikubi, Kagoshima

Carbonized wood trunk from Ushikubi, Aoyama-machi, Sendai City, Kagoshima Prefecture (31° 46' N Lat, 130° 17' E Long), in pumice flow deposit of several meters. Coll. and subm. 1964 by R. Ōta, Geol. Survey of Japan. *Comment*: pumice flow is supposed to be Ito but date conflicts with this view.

Itami series, Osaka

Wood from terrace and alluvial deposits at Itami City. Series provides information on development of topography in Itami area and on date of thick marine clay bed which is widespread in Osaka and Amagasaki areas, overlain by alluvial deposits. Coll. and subm. 1964 by Kazuo Huzita, Osaka City Univ.

29,800 ± 1200
27,850 B.C.

GaK-489. Kamikushiro, Kawanishi City

Charred wood from Kamikushiro, Kawanishi City (34° 48' N Lat, 135° 24' E Long), imbedded in Itami Terrace gravel layer. *Comment* (K.H.): dates Lower Terrace in Osaka Basin.

2700 ± 90
750 B.C.

GaK-490. Mokawa 1, Itami

Wood from under bottom of Kokawa River, Noda, Itami City (34° 46' 30" N Lat, 135° 24' E Long), imbedded in lower part of upper gravel layer.

5960 ± 90
4010 B.C.

GaK-491. Mokawa 2, Itami

Wood from same site as GaK-490, imbedded in blue sand layer below sample GaK-490.

Toyama series

Samples are related to development of alluvial deposits and change of shore line of Toyama Bay. Subm. 1964 by S. Fujii, Toyama Univ.

610 ± 100
A.D. 1340

GaK-538. Shibakusa

Wood from river cliff at Shibakusa, Mizuhashi-machi, Toyama Prefecture (36° 44' N Lat, 137° 17' E Long), just beneath pebble layer, 275 cm below surface of ground. Coll. 1964 by S. Fujii. *Comment* (S.F.): dates deposition of pebble layer which is supposed to have been caused by an earthquake in A.D. 1858.

2730 ± 90
780 B.C.

GaK-539. Uchiide

Wood from sea shore of Uchiide, Yokata-machi, Toyama City (36° 45' N Lat, 137° 13' 28" E Long), ca. 5 m below sealevel. Coll. by T. Takase.

1560 ± 110
A.D. 390

GaK-540. Higashikusano

Wood from buried forest at Higashikusano, Asahi-machi, Toyama Prefecture (36° 58' N Lat, 137° 34' E Long). Coll. 1962 by S. Fujii. Buried surface of woody layer is 2 m above present sealevel. *Comment*: see GaK-541 and GaK-563 of this series.

1750 ± 90
A.D. 200

GaK-563. Uozu

Humic soil from Uozu, Toyama Prefecture (36° 49' N Lat, 137° 23' E Long), 2.0 to 2.4 m below surface. Coll. 1964 by S. Fujii. *Comment*: dates buried ground surface of submerged forest. A tree of the same forest was dated by GaK-246 as 1960 ± 70 B.P. (Gakushuin II).

1950 ± 90
A.D. 0

GaK-541. Jinzugawa

Wood from river mouth of Jinzugawa, Kusazima, Toyama Prefecture (36° 44' N Lat, 137° 15' E Long), ca. 4 m below sealevel. Coll. 1963 by S. Fujii. *Comment*: see Fujii (1965).

3780 ± 100
1830 B.C.

GaK-560. Hakko

Peat from Hakko, Shimomura, Toyama Prefecture (36° 44' N Lat, 137° 7.5' E Long), 1.5 m below surface. Coll. 1964 by T. Takase and N. Fujii, Kanazawa Univ. *Comment*: dates alluvial peat deposit and submerged forests in Shimomura area.

1400 ± 90
A.D. 550

GaK-562. Hamabiraki, Shinminato

Peat from Hamabiraki, Shinminato City, Toyama Prefecture (36° 46' N Lat, 137° 9' E Long), overlain by new sand dune at present sealevel. Coll. 1963 by N. Fujii.

Niigata Plain series

Samples are taken from exploratory borings in Niigata Plain, S or SW of Niigata City. Subsurface information from borings in Niigata

Plain permits partial reconstruction of late-Quaternary sedimentary basin, now filled. Samples are coll. from beds of peat or peaty clay interbedded with sand, silt or sandy gravel which are interpreted as dunes, deltaic gravel, and natural levees. Coll. and subm. 1963 by Kunio Suyama, Satoru Ōya and Yuichiro Takahashi, Fukada Geol. Inst.

GaK-430. Sone, -15 m **>31,000**

Peaty clay from boring B-21 at Sone, Nishikambara-gun, Niigata Prefecture (37° 47' N Lat, 138° 55' E Long), just below the gravel layer, 165 m below surface.

GaK-431. Sone, -145 m **20,900 ± 600**
18,950 B.C.

Peat from boring B-21, just above gravel layer and overlain by sand, 145 m below surface.

GaK-432. Yotsugo, -148 m **25,500 ± 1100**
23,550 B.C.

Peat from boring B-11, ca. 4 km E of B-21, Yotsugo, Nishikambara-gun, Niigata Prefecture (37° 47' 30" N Lat, 138° 58' E Long), from peaty layer underlain by gravel layer, overlain by sand.

GaK-433. Yotsugo, -143 m **20,300 ± 600**
18,350 B.C.

Peat from boring B-11, 143 m below surface.

GaK-434. Yotsugo, -136 m **10,900 ± 250**
8950 B.C.

Peat from boring B-11, 136 m below surface.

GaK-435. Akatsuka, -127 m **18,300 ± 500**
16,350 B.C.

Peat from boring B-20, ca. 4 km N of B-21, Akatsuka, Nishikambara-gun, Niigata Prefecture (37° 49' N Lat, 138° 54' E Long), underlain by gravel layer, 127 m below surface.

GaK-436. Kamikiyama, -94 m **26,200 ± 1000**
24,250 B.C.

Peat from boring B-7, ca. 11 km SE of B-21, Kamikiyama, Niigata Prefecture (37° 44' 30" N Lat, 139° 2' E Long), underlain by gravel layer, 94 m below surface.

GaK-437. Kamikiyaka, -90 m **23,000 ± 1000**
21,050 B.C.

Peat from boring B-7, 85 m below surface.

GaK-439. Uchikoshi, -18 m **4150 ± 120**
2200 B.C.

Peat from boring B-22, 5 km S of B-21, Uchikoshi, Nishikambara-gun, Niigata Prefecture (37° 43' N Lat, 138° 57' E Long), underlain by sand, 18 m below surface.

- 1920 \pm 90**
- GaK-467. Kameda-go, -6 m** **A.D. 30**
 Peat from boring No. 5 at Kameda-go Nakakambara-gun, Niigata Prefecture (37° 53' N Lat, 139° 4' E Long), 6 m below surface.

- 11,700 \pm 280**
- GaK-468. Washimaki, -132 m** **9750 B.C.**
 Peat from boring B-12 at Kameda-go, Nakakambara-gun, Niigata Prefecture (37° 49' N Lat, 139° 3' E Long), 132 m below surface.

Mt. Fuji series

Natural charcoal taken from basaltic ejecta from Mt. Fuji. Coll. and subm. 1964 by Hiromichi Tsuya, Tokyo Univ. *Comment* (H.T.): dates the eruption which produced the charcoals.

- 890 \pm 90**
- GaK-633. Komitake** **A.D. 1060**
 Charcoal from Komitake, N flank of Volcano Fuji (35° 50' N Lat, 138° 44' E Long), alt 2320 m, imbedded in volcanic ash and scoria, 50 cm below surface.

- 1230 \pm 90**
- GaK-634. Inno-Tainai** **A.D. 720**
 Charcoal from inside of a lava-tree mould formed by the Inno-Tainai lava flow, SE foot of Volcano Fuji, Inno-mura, Shizuoka Prefecture (35° 17' N Lat, 138° 51' E Long).

- 470 \pm 80**
- GaK-635. Fujimiya** **A.D. 1480**
 Charcoal from volcanic ash bed lying just below bottom of a basaltic lava flow, SW flank of Volcano Fuji (35° 20' N Lat, 138° 44' E Long), alt 2300 m.

- 630 \pm 80**
- GaK-636. Oniwa** **A.D. 1320**
 Charcoal from volcanic ash bed lying just below bottom of a basaltic lava flow, Oniwa, NW flank of Volcano Fuji (35° 23' N Lat, 138° 42' E Long), alt 2200 m.

B. Australia

Robe beach deposit series

Marine shells (*Katelsia rhytophora* is prominent) from marine beach deposits near Robe, South Australia. Coll. and subm. by G. Blackburn, Div. of Soil, CSIRO. *Comment* (G.B.): dates latest time when marine conditions were present at the localities, and gives maximal ages of overlying soils. Deposits referred to by Sprigg (1952).

- 4330 \pm 110**
- GaK-607. Robe** **2380 B.C.**
 Taken from 5 mi ESE from Robe, South Australia (37° 12' S Lat, 139° 50' E Long), 6 ft above sealevel, overlain by juvenile soil. Coll. 1961.

GaK-608. Konetta **>45,000**

Taken from 19 mi ESE from Robe, South Australia ($37^{\circ} 16' \text{ S Lat}$, $140^{\circ} 5' \text{ E Long}$), 34 ft above sealevel. Occurred in drain exposure at ca. 2 ft below soil surface. Coll. 1961.

GaK-656. Woakwine Range **24,950 \pm 300**
23,000 B.C.

Katelysia rhytiphora, *Anadara trapezia*, *Fulvia racketti* and *Ostrea* from beach deposits ca. 40 ft above sealevel on inland fringe of Woakwine Range, 6.5 mi E from Robe, South Australia ($37^{\circ} 10' \text{ S Lat}$, $139^{\circ} 52' \text{ E Long}$), 21 to 24 in. below surface. Coll. 1965.

GaK-655. Salt Creek, Coorong **30,600 \pm 450**
28,650 B.C.

Shells of *Macra australis* from Salt Creek, Coorong, South Australia ($36^{\circ} 8' \text{ S Lat}$, $139^{\circ} 38' \text{ E Long}$), ca. 70 mi N of Robe, imbedded in beach deposit ca. 12 ft above water level in Coorong (coastal lagoon open to sea). Coll. and subm. 1965 by G. Blackburn. *Comment* (G.B.): dates marine conditions at this point and adjacent soil.

GaK-609. Mt. Gambier **1410 \pm 90**
A.D. 540

Charcoal apparently of tree root burnt during deposition of volcanic ash from Mt. Gambier, ca. 70 mi SE of Robe, imbedded in siliceous sand covered with 12 in. ash layer, 3 mi SSE of Mt. Gambier, South Australia ($37^{\circ} 53' \text{ S Lat}$, $140^{\circ} 46' \text{ E Long}$). Coll. 1956 and subm. by G. Blackburn. *Comment* (G.B.): appears to date ash deposit, but similar charcoal under volcanic ash 5 mi N from this site was dated as 4830 B.P. by NZ-33 (Fergusson and Rafter, 1957).

GaK-486. Frerentin Valley, Tasmania **14,200 \pm 700**
12,250 B.C.

Charcoal from Frerentin Valley, Tasmania ($42^{\circ} 37' \text{ S Lat}$, $146^{\circ} 27' \text{ E Long}$), in a soil profile buried beneath solifluction material thought to be periglacial in origin. Coll. 1963 by J. L. Davies and G. M. Dimmock; subm. by J. L. Davies, Univ. of Tasmania. *Comment* (J.L.D.): gives a maximum age for period of solifluction.

Barilla Valley series, Tasmania

Charcoal from Barilla Valley near Cambridge, Tasmania ($42^{\circ} 30' \text{ S Lat}$, $147^{\circ} 26' \text{ E Long}$). Subm. by J. L. Davies. *Comment* (J.L.D.): dates of gravel and silt deposits give a chronology of denudation and aggradation in this area; it is hoped the gravels may be linked to the fossil raised beaches on the coast.

GaK-487. Barilla Valley, 1 **7900 \pm 460**
5950 B.C.

Charcoal from near base of valley gravels which conceal rock floor of the valley. Coll. 1964 by J. L. Davies.

GaK-488. Barilla Valley, 2**4650 ± 120****2700 B.C.**

Charcoal from near base of valley gravels. Coll. 1964 by J. L. Davies.

GaK-651. Barilla Valley, 7**1160 ± 100****A.D. 790**

Charcoal from sandy silt layer lying in younger gravels, 1 m below ground surface. Coll. 1965 by N. Stephens and J. L. Davies.

Low raised beach series, Tasmania

Samples from beach sands assigned to the postglacial "Milford Level," Tasmania. Coll. 1964 and subm. by J. L. Davies. *Comment* (J.L.D.): suggest two periods of slightly higher sealevel in postglacial time.

GaK-647. Marion Bay, Tasmania**390 ± 90****A.D. 1560**

Carbonized drift wood contained in shell bed below sand forming a part of raised beach, 0.2 m above H.W.M.S.T., at inner side of spit between Marion Bay and Blackman Bay, Tasmania (42° 50' S Lat, 147° 52' E Long). Coll. by N. Stephens and G. Van de Geer.

GaK-648. Tinderbox, Tasmania**260 ± 70****A.D. 1690**

Shells from raised beach, 0.5 to 2 m above H.W.M.S.T., between NW Bay and Derwent estuary, Tasmania (43° 3' S Lat, 147° 19' E Long). Coll. by N. Stephens.

GaK-649. Snug, Tasmania**2760 ± 120****810 B.C.**

Shells from raised beach sands, 1.7 m below H.W.M.S.T. at Snug, Tasmania (43° 4' S Lat, 147° 16' E Long). Coll. by N. Stephens and G. Van de Geer.

GaK-650. Cremorne, Tasmania**3620 ± 80****1670 B.C.**

Carbonized drift wood from shell bed 1.2 m below surface of ground part of a raised beach 1.3 m above H.W.M.S.T. at NE side of Pipe Clay Lagoon. Cremorne, Tasmania (42° 57' S Lat, 147° 31' E Long). Coll. by N. Stephens and G. Van de Geer.

GaK-652. Smithton, Tasmania**22,700 ± 1100****20,750 B.C.**

Shells from shell deposit below tidal channel between Perkins Island and mainland, near Smithton (40° 37' 39" S Lat, 145° 2' E Long), ca. 3 m below H.W.M.S.T., sealed by 2 m of sands deposited as part of a beach or dune ridge. Coll. 1965 by Davies and G. Van de Geer; subm. by J. L. Davies.

*C. Pacific***Managalase series, Papua**

Charcoal from dacitic ash layers of the Managalase, Northern District, Papua (9° S Lat, 148° 20' E Long). Coll. and subm. 1964 by B. P. Ruxton, Div. of Land Res. CSIRO. *Comment* (B.P.R.): dates the upper ash layers around Mount Lamington (see Ruxton, 1965).

GaK-542. Managalase, S78 a **6800 ± 250**
4850 B.C.

Top charcoal layer, 25 to 28 in. from surface.

GaK-543. Managalase, S78 b **15,600 ± 500**
13,650 B.C.

Second charcoal layer, 60 to 67 in. from surface.

GaK-544. Managalase, S78 c **20,100 ± 500**
18,150 B.C.

Third charcoal layer, 90 in. from surface.

GaK-545. Managalase, T1 **7930 ± 370**
5980 B.C.

Top charcoal layer, 3 ft from surface.

Buka Island series

Shell and coral from raised reef on Buka Island, Bougainville (5° S Lat, 154° 30' E Long). Coll. and subm. 1964 by J. G. Speight, Div. of Land Res. CSIRO. *Comment* (J.G.S.): uplift is certainly pre-Holocene.

GaK-546. Buka Island, S136 **>33,500**

Shell of giant clam from upper surface of tectonically raised coral reef at Tohatsi, 300 ft above sealevel.

GaK-547. Buka Island, S157 **>33,000**

Coral from cave at Melasang in base of same raised reef as GaK-546.

*D. Antarctica***Macquarie Island series**

Fossil bird bone from Macquarie Island (54° 30' S Lat, 159° E Long). Subm. by J. McNally, Nat. Mus. of Victoria. *Comment*: dated based on organic carbon extracted by method described in the introduction. Ages are calculated without consideration of any anomaly of C¹⁴ concentration in Antarctic region.

GaK-643. Macquarie Island, No. 14 **6100 ± 120**
4150 B.C.

Fossil bone of Royal Penguin from strata in bank of Finch Creek, Macquarie Island, 20 ft above sealevel. Coll. 1957 by A. R. McEvey and Whitten. *Comment*: see notes by Blake in a paper by D. Mawson (1943).

3980 ± 140**GaK-644. Macquarie Island, No. 17****2030 B.C.**

Fossil bone of King Penguin from W coast of Bauer Bay, Macquarie Island, under present Royal Penguin rookery, 24 ft under present surface. Coll. 1962 by W. J. M. Vestjens, Div. Wildlife Res. CSIRO.

III. ARCHAEOLOGIC SAMPLES

A. North America

3210 ± 90**GaK-504. Cooper County, Missouri****1260 B.C.**

Charcoal from site 23CP40, Cooper County, Missouri (38° 44' N Lat, 93° W Long), 152 cm deep. Sample occurred in general fill of cultural deposit within bluff shelter on Lamine River in central Missouri. Coll. 1959 by H. Collins and subm. by J. M. Shippee, Kansas City Archaeol. Soc. *Comment* (J.M.S.): cultural material exists in this deposit to depth of 3 m. Lanceolate projectile points (Sedalia complex) occur in deeper levels.

870 ± 80**GaK-590. Platte County, Missouri****A.D. 1080**

Charcoal from site of Steed-Kisker, 23PL13, Platte County, Missouri (39° 17' 15" N Lat, 94° 49' 30" W Long). Taken from large pit 155 cm deep. Coll. 1964 by R. B. Aker and subm. by J. M. Shippee. *Comment* (J.M.S.): dates refuse of Indians of Middle Mississippian culture in Kansas City area.

470 ± 80**GaK-591. Barton County, 14BT420, Kansas****A.D. 1480**

Charcoal from Site 14BT420, an earth-lodge village site identified as belonging to Smoky Hill aspect, Central Plains phase, Barton County, Kansas (38° 24' 20" N Lat, 98° 44' 44" W Long), taken from burned timber found on floor of House 1. Coll. 1963 and subm. by T. A. Witty, Kansas State Hist. Soc. *Comment* (T.A.W.): dates construction of House 1 and Smoky Hill occupation. See Graves and Button (1964).

1570 ± 230**GaK-592. Greenwood County, 14GR301, Kansas****A.D. 380**

Charcoal from Curry site, 14GR301, a village site belonging to Middle Woodland period, Greenwood County, Kansas (38° 10' 9" N Lat, 96° 12' 58" W Long), associated with an adult burial. Coll. and subm. 1964 by T. A. Witty. *Comment* (T.A.W.): dates the burial and Woodland occupation. See Curry and Witty (1964).

1040 ± 100**GaK-593. Jewell County, 14JW301, Kansas****A.D. 910**

Charcoal from Site 14JW301, a small earth-lodge village site belonging to Upper Republican focus of Central Plane phase, Jewell County,

Kansas (39° 45' 15" N Lat, 98° 10' 40" W Long), taken from pit in floor of House 1. Coll. and subm. by T. A. Witty.

GaK-594. Lyon County, 14LY301, Kansas **3780 ± 140**
1830 B.C.

Charcoal from Site 14LY301, probably preceramic site marked by deeply buried rock-filled hearths, Lyon County, Kansas (38° 12' 20" N Lat, 96° 17' 39" W Long), taken from large pile of burned sandstone fragments in occupation level. Coll. 1964 by D. Featherstone; subm. by T. A. Witty. *Comment* (T.A.W.): dates possible preceramic occupation of this site, but no diagnostic artifacts are associated with this level.

William Young site series, Morris County

Samples from William Young site, 14MO304, an Archaic campsite assigned to Munkers Creek focus, Morris County, Kansas (38° 44' 50" N Lat, 96° 30' 28" W Long), taken from a rock-filled hearth of the Munkers Creek occupation. Coll. and subm. 1964 by T. A. Witty. *Comment* (T.A.W.): see Witty (1962a) and GaK-297 (Gakushuin III).

GaK-595. Morris County, 14MO304, 1 **3100 ± 400**
1150 B.C.
Taken from lower level of occupation.

GaK-596. Morris County, 14MO304, 2 **3400 ± 500**
1450 B.C.
Taken from upper level of occupation.

GaK-597. Morris County, 14MO308, Kansas **460 ± 100**
A.D. 1490

Charcoal from Slough Creek site, 14MO308, Morris County, Kansas (38° 42' N Lat, 96° 32' 20" W Long), taken from storage pit in floor of House 1. Coll. and subm. 1964 by T. A. Witty. *Comment* (T.A.W.): site appears to be late Middle Woodland village. Previous dating GaK-298, 390 ± 120 (Gakushuin III) was too recent but confirmed. See Witty (1962a).

GaK-598. Montgomery County, 14MY309, Kansas **3680 ± 180**
1730 B.C.

Charcoal from site 14MY309, Montgomery County, Kansas (37° 15' 45" N Lat, 95° 50' 19" W Long), a deeply buried occupation level which probably represents a preceramic Archaic campsite, taken from an exposed hearth buried 24 ft below surface. Coll. 1964 by W. Frantz; subm. by T. A. Witty.

GaK-599. Montgomery County, 14MY316, Kansas **1050 ± 100**
A.D. 900

Charcoal from site 14MY316, Montgomery County, Kansas (37° 15' 30" N Lat, 95° 51' 11" W Long), taken from a post hole in a Middle Woodland lodge. Hopewell potsherds were present in the associated mid-

den. Coll. 1964 by W. F. Weakly; subm. by T. A. Witty. *Comment* (T.A.W.): see Witty (1962b).

GaK-600. Montgomery County, 14MY355, 760 ± 90
Kansas A.D. 1190

Charcoal from Site 14MY355, a late Middle Woodland village, Montgomery County, Kansas (37° 16' 54" N Lat, 95° 46' 45" W Long), taken from trash-filled storage pit. Coll. 1964 by K. R. McWilliams; subm. by T. A. Witty.

GaK-637. Mitchell County, 14ML8, Kansas 455 ± 90
A.D. 1495

Charcoal from roof beam at Site 14ML8, Mitchell County, Kansas (39° 29' 18" N Lat, 98° 19' 58" W Long), 1.6 to 1.8 ft below surface. Coll. 1964 and subm. 1965 by J. O. Marshall and P. Holder, Univ. of Nebraska. *Comment* (P.H.): the archaeological situation at 14ML8 is unclear, but there seem to be 2 components, one possibly affiliated with Keith focus Woodland manifestations and the other with the Aksarben aspect. The cultural debris associated with the carbon sample indicates an affiliation with the Aksarben aspect, and the date, while possible, is unlikely; too recent.

GaK-638. Mitchell County, 14ML16, Kansas 760 ± 90
A.D. 1190

Charcoal from pit in burial complex at Site 14ML16, Mitchell County, Kansas (39° 27' 0" N Lat, 98° 27' 14" W Long). Coll. 1964 by D. R. Yancey and subm. 1965 by J. O. Marshall. *Comment* (P.H.): cultural debris indicated an association with the Aksarben aspect and burial practices suggest influence from Mississippian cultures to the East. An early date but entirely possible.

Mitchell County, 14ML5 series

Charcoal from Site 14ML5, Mitchell County, Kansas (39° 29' 40" N Lat, 98° 27' 30" W Long). Coll. 1964 and subm. by J. O. Marshall.

GaK-639. Mitchell County, 14ML5, 1 610 ± 100
A.D. 1340

From a midden area 1.4 ft deep. Coll. by A. Ahrendts. *Comment* (P.H.): cultural debris indicates an association with the Aksarben aspect and date falls within the estimated range for Aksarben sites.

GaK-640. Mitchell County, 14ML5, 2 230 ± 90
A.D. 1720

From a postmould presumed to lie on periphery of a house of Aksarben affiliation. Coll. by J. O. Marshall. *Comment* (P.H.): cultural debris associated with carbon sample suggests an Aksarben affiliation but date is far too recent. Debris of historic European derivation was found above house floor and the postmould may represent an intrusive late feature.

B. Japan

GaK-536. Kotake Shell Mound **4800 ± 200**
2850 B.C.

Shells from Kotake Shell Mound, Kureha-machi, Toyama Prefecture (36° 43' N Lat, 137° 13' 25" E Long), 180 cm below surface. Site is 4 km distant from present shore line. Coll. and subm. 1964 by S. Fujii, Toyama Univ. *Comment* (S.F.): dates Early Jomon in Hokuriku, Honshu Island, and change of shore line.

GaK-561. Taikoyama **1600 ± 90**
A.D. 350

Charcoal from Nakayama Minami remains, House 2, Taikoyama, Kosugi-machi, Toyama Prefecture (36° 42' N Lat, 137° 6' E Long), 100 cm below surface, associated with Hajiki potsherds. Coll. 1963 by N. Fuji, Kanazawa Univ.

Bibi shell mound series, Hokkaido

Charcoal from Bibi shell mound, Chitose City, Hokkaido (43° 10' 30" N Lat, 141° 40' E Long), alt 20 m. Site is 17 km from present shore line. Coll. and subm. 1964 by Wataru Matsushita, Chitose City. *Comment*: dates the associated remains, advance of shore line, and Tarumae volcanic ash Layer Td (Yamada *et al.*, 1963). Dating by hydration layer of obsidian gave 4600 B.P. (Katsui *et al.*, 1964).

GaK-484. Bibi shell mound, -30 cm **3800 ± 140**
1850 B.C.

Charcoal from 30 cm below surface of shell deposit.

GaK-485. Bibi shell mound, -80 cm **4500 ± 140**
2550 B.C.

Charcoal from 80 cm below surface of shell deposit, just above thin humus layer underlain by Tarumae pumice Td.

C. Australia

Malangangerr series, N.T.

Site is shelter in a large weathered block of sandstone ca. 0.5 mi from East Alligator River and ca. 23 mi from sea, Malangangerr, Arnhem Land, Northern Territory (12° 27' S Lat, 132° 57' E Long), alt ca. 25 ft. Coll. and subm. 1964 by Carmel White, Australian Nat. Univ. *Comment* (C.W.): more samples were collected from these sites and it is hoped that further tests will be made later.

GaK-626. Malangangerr, 1 **370 ± 80**
A.D. 1580

Wood charcoal from M sq. 6C, a hearth in a shell midden 8 to 10 cm from surface, associated with bifacial point industry.

GaK-627. Malangangerr, 2**5980 ± 140****4030 B.C.**

Charcoal from M sq. 6D, a hearth 85 to 90 cm from surface which rests on a shelf of rock with several grinding hollows. *Comment* (C.W.): date should provide a terminus ante quem for the making and use of the grinding hollow.

GaK-628. Malangangerr, 3**19,600 ± 550****17,650 B.C.**

Charcoal near 2 polished grooved axes, from sq. 2A in sand 150 to 154 cm below surface. *Comment* (C.W.): dates of GaK-628 and GaK-629 are surprisingly high and further confirmation is required before these can be accepted.

GaK-629. Malangangerr, 4**22,700 ± 700****20,750 B.C.**

Charcoal from M sq. 5B in sandy loam 138 cm below surface, associated with several retouched flakes.

Tyimedee 1 series, N.T.

Wood charcoal from site Tyimedee 1, a small shelter at base of cliff of Kombolgie sandstone, Arnhem Land, Northern Territory (12° 25' S Lat, 133° 15' E Long). The basal deposit, ca. 100 cm deep, is heavily iron-stained sandstone overlain by yellow-brown sand which grades into the upper level of gray-brown sand. Coll. and subm. 1964 by Carmel White.

GaK-630. Tyimedee 1, 1**Modern <230**

Grey-brown sand, 0 to 5 cm below surface. From top 5 cm associated with stone spear points.

GaK-631. Tyimedee 1, 2**1900 ± 90****A.D. 50**

From yellow sand layer, 61 cm below surface, associated with bifacial points.

GaK-632. Tyimedee 1, 3**10,790 ± 200****8840 B.C.**

From yellow sand layer, 61 cm below surface, associated with bifacial points. *Comment* (C.W.): date is surprisingly high since sample is associated with same cultural material as GaK-631; it requires further confirmation before it can be accepted.

Kenniff cave series, Queensland

Charcoal from Kenniff cave, Queensland (24° 52' S Lat, 148° 2' E Long). Earlier excavations and datings (NPL-32 and NPL-33: National Physical Lab. I; NPL-65, NPL-66, NPL-67 and NPL-68: National Physical Lab. II) showed stratified floor of human occupation to a depth of 11 ft. Coll. and subm. 1964 by D. J. Mulvaney, Australian Nat. Univ. Mulvaney and Joyce (1965) provided detailed comments.

- GaK-522. Kenniff cave, No. 3** **1600 ± 100**
A.D. 350
Tr.B, Sq.1, Spit 6, 15 in. to 17 in. from surface. *Comment* (D.J.M.): post-dates the latest appearance of backed-blade implement types, including geometric microliths. Consistent with NPL-32, 65.
- GaK-523. Kenniff cave, No. 14** **4130 ± 90**
2180 B.C.
Tr.B, Sq:4, Spit b, 3 ft 9 in. from surface. *Comment* (D.J.M.): pre-dates earliest appearance of backed-blade implement types; period of Pirri point use. Consistent with NPL-65, 66.
- GaK-524. Kenniff cave, No. 15** **5370 ± 140**
3420 B.C.
Tr.B, Sq.4, Spit e, 4 ft 4 in. to 4 ft 6 in. from surface. *Comment* (D.J.M.): is stratigraphically older than GaK-525. Consistent with NPL-66.
- GaK-525. Kenniff cave, No. 24** **4650 ± 100**
2700 B.C.
Tr.A, Sq.1, Spit 18, 4 ft 6 in. to 4 ft 9 in. from surface. *Comment* (D.J.M.): collected from the infilling of an eroded hollow. Stratigraphically younger than GaK-524; consistent with NPL-66.
- GaK-526. Kenniff cave, No. 21** **13,200 ± 300**
11,250 B.C.
Tr.C, Sq.5, Spit w, 8 ft 11 in. to 9 ft 3 in. from surface. *Comment* (D.J.M.): NPL-67, 33, 68, all collected between 5 ft 7 in. and 7 ft 8 in., are chronologically older than this sample; no source of contamination evident.
- GaK-527. Kenniff cave, No. 23** **9300 ± 200**
7350 B.C.
Tr.C, Sq.4-5, Spit y, 10 ft 6 in. to 10 ft 9 in. from surface. *Comment* (D.J.M.): this, and GaK-645, cannot be reconciled with the stratigraphically more recent GaK dates above, or with all the NPL dates. Source of possible error is unknown. Further samples will be submitted in hope of clarification.
- GaK-645. Kenniff cave, No. 22** **9650 ± 100**
7700 B.C.
Tr.B, Sq.24, Spit y, closest in depth to GaK-527 but coll. from wider area than GaK-527. 10 ft 3 in. to 10 ft 6 in. from surface. *Comment* (D.J.M.): see above, GaK-527.
- GaK-646. Kenniff cave, No. 16** **10,280 ± 180**
8330 B.C.
Tr.B, Sq:4, Spit h, 5 ft 2 in. to 5 ft 4 in. from surface. *Comment* (D.J.M.): consistent with NPL-67.

Wombah midden series

Samples coll. during excavation in 1964 at Wombah middens, Site 1, one of a series of middens at Wombah, near Iluka, on N bank of Clarence River, Northern New South Wales, 8 mi W of its mouth (29° 22' S Lat, 153° 17' E Long). Coll. and subm. 1964 by I. McBryde, Univ. of New England.

General Comment (I.M.): samples were taken from a grid of squares excavated ca. 50 yd to E of those excavated in 1963 from which samples have already been dated (GaK-374, 375, 376, Gakushuin IV). Also see McBryde (1965). Dates given here supplement those already received for the site. Cultural material from this site included uniface pebble artifacts, and some backed blades, but site as a whole not rich in artifacts.

2960 ± 120
1010 B.C.

GaK-564. Wombah Site 1, 1

Charcoal from Sq. f, Level IIA, Spit 2, section of main shell layer in the midden, at depth of 13 to 14 in. below surface.

2930 ± 100
980 B.C.

GaK-565. Wombah Site 1, 2

Charcoal from Sq. f, Level IIA, Spit 3, lowest part of main shell layer, 25 to 27 in. below surface. *Comment* (I.M.): stratified below GaK-564 so that the more recent result here is surprising, though the two dates are very close. Associated cultural material included blade tools, with some Bondi points.

1530 ± 90
A.D. 420

GaK-566. Wombah Site 1, 3

Charcoal from Sq. g, Level IIA, Spit 1, upper part of main shell layer, 17 to 18 in. below surface, *Comment* (I.M.): as expected from stratigraphic position, date is more recent than GaK-564 and 565.

3040 ± 120
1090 B.C.

GaK-567. Wombah Site 1, 4

Charcoal from Sq. k, Level IIA, Spit 3, a heavy concentration of shells in lower part of main shell layer of deposit, 18 in. below surface. *Comment* (I.M.): from its stratigraphic position date was expected to be in accord with GaK-565. Sample was associated with part of a broken ground-edged implement, giving interesting evidence on the antiquity of this type of artifact in northern New South Wales.

3230 ± 100
1280 B.C.

GaK-568. Wombah Site 1, 5

Charcoal from Sq. h, Level VIII, earliest stratigraphic level showing signs of human occupation on the site, at depth of 22 to 26 in. below surface. Associated artifacts included blade and uniface pebble tools. *Comment* (I.M.): date should be in accord with GaK-376, 2870 ± 130 B.P. (Gakushuin IV).

Bendemeer rock shelter series

Site is situated in Moonbi Range, near Hall's Creek, ca. 10 mi W of Bendemeer in northern New South Wales (30° 53' S Lat, 151° 2' E Long). Occupation deposit excavated was protected by the overhang of a large granite boulder which bears paintings in red ocher. Samples whose dates are given here were collected from upper two levels of deposit, and are stratified above levels which were richest in cultural material, yielding backed blades (Bondi points and geometric microliths), some burins, and two ground-edged axes.

General Comment (I.M.): dates will give an indication of chronology of this blade tool industry which is similar to that of "Bondaian" sites in eastern NSW to the South; will also date the blade tools found in the upper levels directly associated with the samples.

410 ± 40

GaK-569. Bendemeer Site 1, 1 **A.D. 1540**

Charcoal from Tr. 1, Zone a, Level 1, upper level of deposit, 4 to 5 in. below surface.

740 ± 40

GaK-570. Bendemeer Site 1, 2 **A.D. 1210**

Charcoal from Tr. 1, Zone b, Level 1, upper level of deposit, concentrated in a depression in this level, 7 in. below surface. *Comment* (I.M.): as the deposit here covers part of the red ocher art on the rock surface, date will be a useful indication of date of the art, which must be older than the deposit covering it.

535 ± 40

GaK-571. Bendemeer Site 1, 3

Charcoal from Tr. 1, Zone c, Level 1, upper level of deposit in Zone c, on W side of trench, 2.5 to 3 in. below surface of deposit. *Comment* (I.M.): should be in accord with GaK-569 and 570.

630 ± 40

GaK-572. Bendemeer Site 1, 4 **A.D. 1320**

Charcoal from Tr. 1, Zone c, Level II, a concentration of this material in second stratigraphic level distinguished in deposit, on S side of Zone c, 9 in. below surface. *Comment* (I.M.): sample was stratified below GaK-571 and expected to be older than GaK-569.

*D. Pacific***Aibura cave series, New Guinea**

Samples are taken from a limestone cave, Aibura cave, Tairora Census Division, Kainantu Sub-District, Eastern Highlands District, New Guinea (6° 20' S Lat, 145° 50' E Long). White ashy hearths visible to ca. 70 cm below surface; artifacts continue to ca. 130 cm below surface of ground. Coll. and subm. 1964 by J. P. White, Australian Nat. Univ. *Comment* (J.P.W.): see White (1965) for interim report on site. More

samples were collected from this site and it is hoped that further tests may be made.

770 \pm 100
A.D. 1180

GaK-622. Aibura cave, -50 cm

Charcoal in white ashy lens, Level 4, 50 cm below surface. Associated with ground stone axes and flaked artifacts. Pottery traded from Markham Valley is found down to Level 3 and shells (down to Level 5) were traded in from coast ca. 120 mi distant. *Comment* (J.P.W.): dates approximately the beginning of trade with the lowlands and coast.

3800 \pm 110
1850 B.C.

GaK-623. Aibura cave, -122 cm

Charcoal in soil matrix, 122 cm below surface. *Comment* (J.P.W.): probably dates earliest remains of occupation at site.

Kosipe series, Papua

Samples are taken from ridge-top site, Kosipe, 11 mi NNW of Woi tape Government Station, Vetapu Census Div., Goilala Sub-District, Central District, Papua (8° 30' S Lat, 147° 20' E Long). Samples occur as loose carbon in buried soil layer. Coll. and subm. 1964 by J. P. White. *General Comment* (J.P.W.): samples should date period of use of waisted blades and, especially, mortars found in the buried soil layer, but dates of GaK-624 and GaK-625 are surprisingly high and further confirmation is required before these dates can be accepted. See White (1965). More samples have been collected.

16,300 \pm 1200
14,350 B.C.

GaK-624. Kosipe, Papua, -74 cm

Charcoal from buried soil, ca. 30 cm below top of buried soil.

19,350 \pm 600
17,400 B.C.

GaK-625. Kosipe, Papua, -75 cm

Carbonaceous soil from ca. 10 cm below top of buried soil.

REFERENCES

Date lists:

Arizona II	Damon and Long, 1962
Arizona IV	Damon, Long, and Sigalove, 1964
British Museum I	Barker and Mackey, 1959
Gakushuin II	Kigoshi and Endo, 1963
Gakushuin III	Kigoshi, Lin, and Endo, 1964
Gakushuin IV	Kigoshi, Kobayashi, 1965
NPL I	Callow, Baker, and Pritchard, 1962
NPL II	Callow Baker, and Pritchard, 1963
New Zealand III	Fergusson and Rafter, 1957
Pennsylvania III	Ralph, 1959
Pennsylvania VIII	Stuckenrath and Ralph, 1965
UCLA I	Fergusson and Libby, 1962
UCLA IV	Berger, Fergusson, and Libby, 1965

Curry, H. C., and Witty, T. A., 1964, Recent excavations in a Woodland burial area, Greenwood County, Kansas: Kansas Anthropol. Assoc. Newsletter, v. 9, no. 9.

- Fergusson, G. J., and Rafter, T. A., 1957, New Zealand ^{14}C age measurements 3: New Zealand Jour. Sci. and Technol., sec. B, v. 38, p. 732-749.
- Fujii, S., 1965, The development of Kurobe fan and submarine forests around the Toyama Bay: Earth Science, v. 76, nos. 7-8, p. 11-20.
- Gohara, Y., 1963, Tephrochronology in Kyushu area: Daiyonki Kenkyu, v. 3, nos. 1-2, p. 123-138.
- Graves, O., and Button, R., 1964, Archeological investigation of Site 14BT420, Barton County, Kansas: Kansas Anthropol. Assoc. Newsletter, v. 9, no. 7.
- Katsui, Y., and Kondo, Y., 1964, Dating of stone implements by using hydration layer of obsidian: Japanese Jour. Geol. and Geog., v. 36, no. 2-4, p. 45-60.
- Kigoshi, K., and Hasegawa, H., 1966, Secular variation of atmospheric radiocarbon concentration and its dependence on geomagnetism: Jour. Geophys. Research, v. 71, no. 4, p. 1065-1071.
- Mawson, D., 1943, Macquarie Island, its geography and geology: Australian Antarctic Expedition 1911-14, Sci. Rept. Ser. A, v. 5.
- McBryde, I., 1965, Radiocarbon dates for archaeological sites in the Clarence Valley, Northern South Wales: Oceania, v. 35, no. 4, p. 260.
- Mulvaney, D. J., and Joyce, R. B., 1965, Report of excavation at Kenniff Cave: Proc. Prehistoric Soc., in press.
- Ruxton, B. P., 1965, Correlation and stratigraphy of dacitic ash-fall layers in North-East Papua: Jour. Geol. Soc. Australia, in press.
- Sprigg, F. C., 1952, The geology of the south-east province, South Australia, with special reference to Quaternary coast line migrations and modern beach developments: Bull. Geol. Surveys S. Australia, v. 29.
- Witty, T. A., 1962a, Archeological field work of the Kansas State Historical Society during the 1962 summer field season: Kansas Anthropol. Newsletter, v. 8, no. 1.
- , 1962b, Archeological survey of the Elk City reservoir: Kansas Anthropol. Assoc. Newsletter, v. 7, no. 7.
- White, J. P., 1965, Archaeological investigations in New Guinea, an interim report: Jour. Polynesian Soc., v. 75, no. 1, p. 40-56.
- Yamada, S., Katsui, Y., and Kondo, Y., 1963, Distribution and chronology of volcanic deposit in Hokkaido: Daiyonki Kenkyu, v. 3, nos. 1-2, p. 80-87.