

PRETORIA RADIOCARBON DATES I

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INTRODUCTION

In 1969 radiocarbon dating facilities were established at the National Physical Research Laboratory of the C.S.I.R. in Pretoria (25° 43' S Lat, 28° 21' E Long; alt 1500 m). The counters are situated in an underground room built of selected concrete and covered by ca. 12 m earth. In this room, the nucleonic component of cosmic radiation is practically absent and the meson flux is reduced by a factor of 3.5 as compared to the surface at sea level in Groningen, Netherlands. A neutron monitor which registers 30 cpm on the surface, counts ca. 0.1 cpm in the underground room.

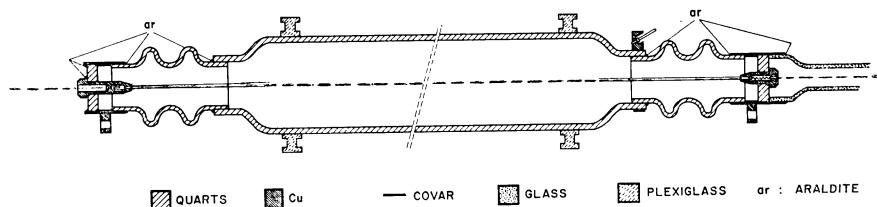


FIG. 1. Radiocarbon counter of quartz glass. Effective length 350 mm, inner diam. 45 mm, wire diam. 0.05 mm.

The two small counters currently in use are of gold-plated quartz glass (Fig. 1). Their construction is designed to incorporate as little foreign material as possible and thus, keep the background, due to radioactive impurities, low. Around the counters are 3 cm old lead, an anti-coincidence ring, and 10 cm selected lead. They have an effective volume of 0.56 L and an initial background of 0.5 and 0.65 cpm. No variation in background due to barometric pressure can be detected. At a filling pressure of 3.5 atm the modern count rate is 12.7 cpm; the figure of merit of the best counter is thus $A/\sqrt{B} = 18$. These small counters are extremely useful for routine measurements since only a little more than 1g of pure carbon is needed for an analysis. In two one-day counts a modern sample is measured to an accuracy of 0.54% or ± 43 years.

The counting gas is CO_2 prepared as described by Vogel and Waterbolk (1967), C^{13} analyses are performed on all samples and given with respect to the PDB standard. Corrections for variations in isotopic fractionation are applied to dates on organic material (wood, peat, charcoal, etc.), but not to marine carbonate (sea shells), because the isotopic fractionation is compensated for by the apparent age of surface ocean water. Dates on fresh water carbonate are also not corrected for isotopic fractionation since the initial C^{14} content is variable. In general, 1300

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± 500 years are to be subtracted from such dates (Münnich and Vogel, 1959).

Dates are reported in conventional radiocarbon years, *i.e.*, using a half-life of 5568 years for C^{14} . The descriptions are mainly compiled on the basis of information supplied by the submitters.

Thanks are due S. Talma of our laboratory for performing the C^{13} analyses, and to J. Schutte for dating assistance in the initial stages.

SAMPLE DESCRIPTIONS

I. GEOLOGIC SAMPLES

Wolkberg Cave series, Transvaal

Calcite samples from Wolkberg Cave (24° 05' S Lat, 29° 55' E Long) 32 km by rd. S of Pietersburg-Tzaneen Rd; on Wolkberg, dist. Pietersburg, Transvaal. Coll. and subm. 1969 by T. C. Partridge, 12 Cluny Rd., Forest Town, Johannesburg.

Pta-285. Wolkberg T2

10,370 \pm 100

8420 B.C.

$\delta C^{13} = -4.49\%$

Center of 45 cm diam. stalactite in Chamber 1, 50 m from entrance.

Pta-105. Wolkberg T10(a)

2820 \pm 60

870 B.C.

$\delta C^{13} = -1.14\%$

Outer part of younger-generation stalagmite 68 m above water table in Chamber 2, 170 m from entrance.

Pta-106. Wolkberg T11(a)

4690 \pm 65

2740 B.C.

$\delta C^{13} = -0.51\%$

Younger-calcite coating over older redissolved stalactite, 68 m above water table in Chamber 2, 170 m from entrance.

Pta-174. Wolkberg T11(b)

30,860 \pm 600

28,910 B.C.

$\delta C^{13} = +0.75\%$

Surface of same older redissolved stalactite as above.

Pta-169. Wolkberg T9

>46,800

$\delta C^{13} = +1.14\%$

Older redissolved stalactite from 68 m above water table in Chamber 2, 170 m from entrance.

Pta-104. Wolkberg T 20

21,100 \pm 200

19,150 B.C.

$\delta C^{13} = +1.87\%$

Younger-generation stalactite 38 m above water table, from wall of lower passage, ca. 360 m from entrance.

General Comment: outer layers of all samples etched off with dilute acid and inner carbonate dated. No correction for isotopic fractionation.

Dates of freshwater calcite may be up to 1300 yr too old (Münnich and Vogel, 1959). Varying ages show no indication of discrete periods of precipitation. T11 suggests period of dissolution between 30,860 B.P. and 4690 B.P.

Pta-103. Ficus Cave, Transvaal **330 ± 50**
A.D. 1620
 $\delta C^{13} = -3.77\%$

Fragments, younger-generation stalactite, 23 m above water table, from Ficus Cave, Makapan Valley (24° 10' S Lat, 29° 15' E Long), 23 km E of Potgietersrust, Transvaal. Coll. and subm. 1969 by T. C. Partridge. *Comment:* outer layers etched off with acid, inner part measured. Calcite precipitation apparently continued to recent times.

Sterkfontein series, Transvaal

Calcite samples from Sterkfontein Cave (26° 02' S Lat, 27° 42' E Long), 6 km NW of Krugersdorp, Transvaal. Coll. and subm. 1969 by T. C. Partridge.

Pta-102. Sterkfontein 2 **>48,000**
Sample of younger-generation stalactite, ca. 4.5 m above water table.

Pta-108. Sterkfontein 11(a) **>47,500**
Center part of younger-generation stalagmite, ca. 4.5 m above water table.

Pta-109. Sterkfontein 11(b) **>50,000**
Outer part of same younger-generation stalagmite as above.

General Comment: outer layer of all samples etched off with acid, inner carbonate measured. Even younger-generation stalactite from this cave underlying Sterkfontein *Australopithecus* cave (and thus of later date) is >50,000 yr.

Morelettaspruit series, Transvaal

Where Morelettaspruit crosses Silverton Ridge, Meyerspark, Pretoria (25° 43' S Lat, 28° 16' E Long), Transvaal, 1.4 m peat overlies 0.8 m sand and clay, 0.6 m coarse gravel, peat, and clay. Samples coll. and subm. 1969 by P. Verhoef and J. C. Vogel.

Pta-129. Morelettaspruit 1.4 m **440 ± 40**
A.D. 1510
 $\delta C^{13} = -23.3\%$

Sample from bottom of upper peat layer at 1.4 m depth.

Pta-128. Morelettaspruit 2.8 m **5220 ± 55**
3270 B.C.
 $\delta C^{13} = -19.6\%$

Sample from top of lower peat layer at 2.8 m depth.
General Comment: pretreated with acid only. Gravel deposit, common in

stream beds in region, deposited between 5220 and 440 yr ago, *i.e.*, apparently before occupation by agriculturalists.

Tietiesbaai series, Cape Province

On coast at Tietiesbaai (31° 10' S Lat, 17° 45' E Long), 47 km W of Bitterfontein, Namaqualand, Cape Prov., series of 6 emerged beaches occurs. Lowest 3 at 2, 5, and 7 m are covered by stabilized berm but exposed by prospecting trenches. Shells coll. and subm. 1969 by A. J. Carrington, South African Mus., Cape Town.

Pta-090. Tietiesbaai, 2m **340 ± 50**
A.D. 1610
 $\delta C^{13} = +1.1\%$

Anthropod shell from top of 2 m emerged beach (back-beach environment) below ca. 2 m berm on coastal farm Tietiesbaai. *Comment:* unexpectedly young age suggests sample does not actually date 2 m beach.

Pta-091. Karoetjieskop A, 5 m **>47,500**
 $\delta C^{13} = +1.8\%$

Anthropod and mollusk shells from 5 m emerged beach (back-beach environment) below ca. 3 m berm on coastal farm Karoetjieskop.

Pta-092. Karoetjieskop B, 5 m **>48,300**
 $\delta C^{13} = +0.2\%$

Anthropod and mollusk shells from 5 m emerged beach (back-beach environment) below ca. 4 m berm on farm Karoetjieskop.

Pta-093. Karoetjieskop C, 7 m **>50,000**
 $\delta C^{13} = -0.2\%$

Mollusk shells from 7 m emerged beach (back-beach environment) below ca. 5 m sand and shell midden on farm Karoetjieskop.

General Comment: about half of carbonate removed with dilute acid; the rest dated. No C^{13} corrections made. Results show +5 m and +7 m beaches not of Pleniglacial age but either Early Glacial or Preglacial. Cf. dates for +2 m terrace at Oranjemund of ca. 35,000 and 38,100 B.P. (R., 1970, v. 12, p. 450) and Saldanha Bay series, below.

Pta-161. Anyskop, Cape Province **35,930 ± 1000**
33,980 B.C.
 $\delta C^{13} = -25.2\%$

Carboniferous clay from Anyskop (32° 57' 30" S Lat, 18° 05' E Long), Vredenburg dist., Cape Prov., 4.6 m below surface and +24 m, underlying phosphate layer, sand, and tufa in prospecting pit. Coll. 1969, subm. 1970 by H. N. Visser, Geol. Survey, Pretoria. *Comment:* pretreated with acid only. Date suggests phosphate layer is late Pleistocene.

Saldanha Bay series, Cape Province

Shell samples from emerged beaches at Peninsula, Saldanha Bay (33°

05' S Lat, 18° 00' E Long), Cape Prov. Coll. and subm. 1969 by R. J. Parker, Marine Geol. Sec., Inst. of Oceanography, Univ. Cape Town.

Pta-094. Kreeftebaai A **40,200 ± 1300**
38,250 B.C.
 $\delta C^{13} = +0.33\%$

Shell fragments assoc. with 3 to 5 m emerged beach, from outcrop on emerged wave-cut terrace at Kreeftebaai.

+ 2600
48,200
- 2200

Pta-095. Luisterhoek B **46,250 B.C.**
 $\delta C^{13} = +2.23\%$

Shell fragments assoc. with 3 to 5 m emerged beach, from outcrop on emerged wave-cut terrace at Luisterhoek.

+ 3600
48,500
- 2900

Pta-096. Churchhaven C **46,550 B.C.**
 $\delta C^{13} = +1.31\%$

Loose shells assoc. with a 3 to 5 m emerged beach, exposed in unconsolidated dune cliff face at Churchhaven, +4.2 m, 3 m below top of cliff.

41,100 ± 1200
39,150 B.C.
 $\delta C^{13} = +0.83\%$

Pta-097. Elandspunt D

Shell fragments assoc. with 15 m emerged beach, exposed in cliff face at Elandspunt, ca. +6.5 m and 6 to 9 m below top of cliff.

>49,500
 $\delta C^{13} = +2.14\%$

Pta-098. Elandspunt E

Shell fragments from same layer as Elandspunt D.

General Comment: before being submitted, Samples A, B, D, E were crushed, washed in boiling water, and secondary carbonate was removed with knife. In lab. half of carbonate etched off with acid; inner part measured. As usual, no correction for C^{13} . Dates may be too young since boiling shells in water can introduce contamination. Small amounts of secondary carbonate can also make dates too young: 3 to 5 m beach thus at least 48,000 B.P., and pre-Pleniglacial, while 15 m beach is >49,500 B.P. (Pta-098). Compare Tietiesbaai series, above.

Pta-171. Cape Flats, Cape Province **>40,500**

Piece of wood found at -4 m in Borehole 223, cor. of Klipfontein Rd. and 5th Ave. (33° 57' 48" S Lat, 18° 30' 31" E Long), Athlone, Cape Town. Coll. by W. R. Ross; subm. 1969 by M. R. Henzen, N.I.W.R., C.S.I.R., Pretoria. *Comment:* pretreated with acid only. Sand filling of Cape Flats Basin thus not of Postglacial date. Compare W-246: >38,000

B.P. (Science, 1956, v. 123, p. 443), Y-49: >38,000 B.P. and Y-106: >36,300 (Science, 1957, v. 126, p. 918) for similar samples.

Pta-250. Bredasdorp, Cape Province

>46,000
 $\delta C^{13} = -25.3\%$

Brown coal 0.6 to 1.8 m deep in lenses in marsh deposit on Malmesbury rocks, exposed during excavation for dam on Tierfontein Farm, Bredasdorp (34° 32' S Lat, 20° 25' E Long), Cape Prov. Coll. and subm. 1970 by H. N. Visser. *Comment*: pretreated with acid only. Deposit not of recent date.

Cape St. Francis series, Cape Province

Shell samples dredged from submerged beaches at different depths off Cape St. Francis, Cape Prov. Coll. and subm. 1969 by R. A. Slater, Marine Geol. Sec., Inst. of Oceanog., Univ. Cape Town.

Pta-183. Cape St. Francis DR-169
7580 ± 70
5630 B.C.
 $\delta C^{13} = +2.4\%$

Oyster shell, -51 m (34° 05.0' S Lat, 24° 11.8' E Long).

Pta-265. Cape St. Francis DR-175
14,510 ± 120
12,560 B.C.
 $\delta C^{13} = +2.5\%$

Oyster shell, -112 m (34° 31.0' S Lat, 24° 30.0' E Long).

Pta-254. Cape St. Francis DR-192
13,670 ± 120
11,720 B.C.
 $\delta C^{13} = +1.5\%$

Calcareous algae, -115 m (34° 24.2' S Lat, 25° 00.0' E Long).

Pta-185. Cape St. Francis DR-183(c)
12,990 ± 110
11,040 B.C.
 $\delta C^{13} = +1.6\%$

Calcareous algae, -120 m (34° 28.9' S Lat, 24° 42.3' E Long).

Pta-182. Cape St. Francis DR-175(c)
16,990 ± 160
15,040 B.C.
 $\delta C^{13} = +1.8\%$

Pecten shell, -130 m (34° 31.0' S Lat, 24° 30.0' E Long).

General Comment: outer half of all samples etched away with acid, inner carbonate measured. Samples date rise in sea level during Late Glacial-Holocene and indicate lowest sea level (-130 m) during Last Glacial occurred ca. 17,000 B.P.

II. ARCHAEOLOGIC SAMPLES

A. Stone Age of Southern Africa

Pta-256. Tuinplaas, Transvaal
5570 ± 100
3620 B.C.
 $\delta C^{13} = +1.1\%$

Calcareous crust on bone from fossil site of Tuinplaas (25° 55' S Lat, 28° 45' E Long), 13 km E of Settlers, Springbokvlakte, Transvaal. Bones assoc. with Tuinplaas skeleton buried in 45 cm calcrete at ca. 90 cm depth. Subm. 1969 by A. Hughes, Univ. of Witwatersrand, Johannesburg. *Comment:* since bone contains no collagen, secondary calcite dated, minimum for Middle Stone age skeleton.

Heuningneskrans series, Transvaal

Rock shelter on farm Heuningneskrans No. 476 (24° 36' S Lat, 30° 39' E Long), 18 km N of Ohrigstad, Lydenburg dist., Transvaal, excavated by P. Beaumont in 1968. Sediment contains 3 Later Stone age (Smithfield) strata: Stratum 3 from 0 to 76 cm, Stratum 2 from 76 to 152 cm and Stratum 1 from 152 cm, to bedrock at 610 cm. Samples coll. and subm. by P. Beaumont, Bernard Price Inst. for Palaeontol., Univ. of Witwatersrand, Johannesburg.

Pta-112. Heuningneskrans 27" **7200 ± 70**
5250 B.C.
 $\delta C^{13} = -18.6\%$

Charred bone from lower part of Stratum 3 at 45 to 70 cm depth in Sq. AB assoc. with early Later Stone age industry with high percentage of scrapers. *Comment:* pretreated as for charred bone (Vogel and Waterbolk, 1963) and alkali soluble fraction measured.

Pta-099. Heuningneskrans 45" **9780 ± 85**
7830 B.C.
 $\delta C^{13} = -24.3\%$

Charcoal fragments from top of Stratum 2 at 76 to 107 cm depth in Sq. A10 assoc. with early Later Stone age industry. *Comment:* pretreated with acid and alkali.

Pta-114. Heuningneskrans 66" **10,430 ± 150**
8480 B.C.
 $\delta C^{13} = -15.9\%$

Charred bone from top of Stratum 1 at 145 to 168 cm depth in Sq. A9 assoc. with early Later Stone age industry. *Comment:* pretreated as Pta-112 above.

Pta-100. Heuningneskrans 93" **13,100 ± 110**
11,150 B.C.
 $\delta C^{13} = -25.2\%$

Charcoal fragments from Stratum 1 at 220 to 235 cm depth in Sqs. A12 and A13. *Comment:* pretreated with acid and alkali.

Pta-233. Heuningneskrans 172" **11,220 ± 140**
9270 B.C.
 $\delta C^{13} = -9.5\%$

Calcrete cementing soil at 430 to 436 cm depth in Sq. C11. *Comment:* half of carbonate etched away with dilute acid and the rest dated. This is no date for level but average for secondary cementing episode; since

apparent age of freshwater carbonate is usually 1300 yr (Münnich and Vogel, 1959), cementing probably took place ca. 10,000 B.P.

Pta-101. Heuningneskrans 174"

24,630 ± 300

22,680 B.C.

$\delta C^{13} = -14.5\%$

Charred bone from hearth at 435 to 442 cm depth in Sq. A12 assoc. with early Later Stone age industry. *Comment:* pretreated as Pta-112 above.

General Comment: dates indicate Stratum 1 top and Stratum 2 contemporaneous with Later Stone age at nearby Bushman Rock Shelter (R., 1970, v. 12, p. 458). Pta-101 shows high antiquity of Later Stone age culture, confirming Rose Cottage series, below.

Pta-004. Mlaula Shelter 2, Swaziland

9570 ± 450

7620 B.C.

$\delta C^{13} = -23.4\%$

Burnt bone fragments, 80 to 100 cm deep, from Later Stone age rock shelter of Mlaula, ca. 8 km SW of Mlaula (26° 12' S Lat, 32° 01' E Long), Swaziland. Coll. 1965, subm. 1967 by P. Beaumont. *Comment:* pretreated as for burnt bone. Cf. Y-1996: 9370 ± 160 for same deposit (R., 1969, v. 11, p. 646).

Pta-163. Umhlanga Rocks, Natal

250 ± 35

A.D. 1700

$\delta C^{13} = -26.6\%$

Charcoal 13 cm below surface, from hearth in open midden site, 150 m N of lighthouse, Umhlanga Rocks beach (29° 41.5' S Lat, 31° 07' E Long), 18 km NE of Durban, Natal, assoc. with Later Stone age Wilton industry. Coll. by R. C. Walsh; subm. 1969 by O. Davies, Natal Mus., Pietermaritzburg. *Comment:* pretreated with acid and alkali. Date shows Later Stone age people lived on coast after arrival of Bantu in area.

Pta-087. Munro's site skeleton, Orange Free State

850 ± 60

A.D. 1100

$\delta C^{13} = -11.2\%$

Bone from leg of skeleton B 10-20 excavated at Munro's site on Vaal R., 1.6 km upstream from Oppermansdrift dam (24° 42' S Lat, 25° 33' E Long), Orange Free State (Mason, 1969). Assoc. with Smithfield Industry. Coll. 1968, subm. 1969 by R. J. Mason, Univ. of Witwatersrand, Johannesburg. *Comment:* inorganic salts removed by repeated treatment with dilute acid and collagen dated. First Later Stone age skeleton dated in area. Cf. Riet R. skeletons, below.

Rose Cottage series, Orange Free State

Further samples from Rose Cottage cave near Ladybrand (29° 15' S Lat, 27° 30' E Long), Orange Free State, analyzed (see R., 1970, v. 12, p. 462). Coll. 1962 by P. Beaumont; subm. 1968 by R. J. Mason.

Pta-350. Rose Cottage sherd

610 ± 50
A.D. 1340
 $\delta C^{13} = -20.8\%$

Sherd of grass-tempered pot from 30 to 37 cm depth in Sq. Fh in uppermost Wilton layer. *Comment:* 80 g sherd contained enough charred grass for analysis. Pretreated with acid. Such potsherds should prove useful to date early pottery traditions in S Africa.

Pta-211. Rose Cottage 4'5"

29,430 ± 520
27,480 B.C.
 $\delta C^{13} = -23.5\%$

Finely dispersed charcoal and ash from Sq. Jf at 135 cm depth in base of pre-Wilton layer. *Comment:* pretreated with acid and alkali. Since all carbon dissolved in hot alkali, this fraction was analyzed. Date could be too young, but, since older than GrN-5300: 25,640 ± 220 B.P. for comparable level at 146 cm (erroneously quoted as 176 cm in R., 1970, v. 12, p. 462) it is considered reliable. Confirms high age of 1st Later Stone age in cave. Both samples overlie primitive Later Stone age assemblage in Malan's (1952) "sterile" layer.

Pta-213. Rose Cottage 10'10"

>50,200
 $\delta C^{13} = -23.8\%$

Fine charcoal and sand from Sq. Hd at 330 cm depth in top of Upper Magosian layer. *Comment:* pretreated with acid and alkali. Since all carbon dissolved in alkali, this fraction was measured. Date could be too young. Confirms high age of Magosian at site.

Pta-214. Rose Cottage 12'4" soluble frac.

>42,500
 $\delta C^{13} = -24.6\%$

Pta-231. Rose Cottage 12'4" insoluble frac.

>48,400
 $\delta C^{13} = -24.7\%$

Charcoal from Sq. Ie at 380 cm depth in lower hearth of Upper Magosian. *Comment:* pretreated with acid and alkali; both alkali soluble and insoluble fractions measured with similar results.

Pta-001. Rose Cottage 12'

36,100 ± 2000
34,150 B.C.

Small sample of fine charcoal from outside grid in Upper Magosian layer. *Comment:* pretreated with acid and alkali. On basis of other minimum dates for Magosian, above, this sample too young and must have been contaminated.

General Comment: these dates and those for Heuningneskrans, above, prove that Later Stone age in South Africa goes back beyond 24,000 B.P., double age hitherto assumed, and that "Magosian" of Rose Cottage is older than 50,000 B.P., as at Montagu Cave (R., 1970, v. 12, p. 460).

Riet River series, Orange Free State

Two graves at Site OFD 1 on bank of Riet R., farm Koppieskraal (29° 18' S Lat, 24° 57' E Long), 12 km N of Koffiefontein, Orange Free

State, excavated in 1969 (Humphreys and Maggs, 1970). Graves possibly related to nearby stone-built settlement. In past 60 or more graves found here (Van Riet Lowe, 1931). Coll. and subm. 1970 by T. Maggs, Dept. of Archaeol., Univ. Cape Town, and A.J.B. Humphreys, McGregor Mus., Kimberley.

Pta-247. Riet River Skeleton 1 **110 ± 50**
A.D. 1840
 $\delta C^{13} = -9.2\%$

Ribs of human skeleton 1.2 m below surface from Burial 1. Ostrich eggshell bead headband of Later Stone age type, and copper pendant found in assoc. Pendant preserved portion of hair and skin of scalp. Hair decorated with specularite. Red ocher used on burial.

Pta-248. Riet River Skeleton 2 **380 ± 50**
A.D. 1570
 $\delta C^{13} = -8.0\%$

Ribs of human skeleton from Burial 2, 1 m below surface.

General Comment: inorganic salts removed with cold acid. Collagen measured. From C^{14} calibration curve (Vogel, 1970) most probable historic dates are either A.D. 1845 or A.D. 1690 for Skeleton 1 and either A.D. 1590 or A.D. 1475 for Skeleton 2.

Doornfontein series, Cape Province

Ancient specularite working on farm Doornfontein M82, 10 km NNW of Postmasburg (28° 18' S Lat, 23° 05' E Long), Cape Prov., excavated by P. Beaumont and A. K. Boshier. Coll. and subm. 1969 by P. Beaumont.

Pta-186. Doornfontein 27"-39" **1120 ± 40**
A.D. 830
 $\delta C^{13} = -21.7\%$

Scattered charcoal nodules in middle levels of mining rubble in Chamber 3, 70 to 100 cm below surface, assoc. with bush-boskop skeletal remains and crude Later Stone age artifacts and "Hottentot" pottery.

Pta-187. Doornfontein 45"-52" **1120 ± 40**
A.D. 830
 $\delta C^{13} = -24.5\%$

Scattered charcoal nodules from basal levels of mining rubble in Chamber 3, 115 to 130 cm below surface (bedrock), assoc. with skeletal remains and crude Later Stone age artifacts.

General Comment: pretreated with acid and alkali.

Pta-251. Baviaanskloof, Cape Province **12,650 ± 100**
10,700 B.C.
 $\delta C^{13} = -23.9\%$

Small charcoal sample from cave in Baviaanskloof Mts. (33° 30' S Lat, 23° 40' E Long), ca. 12 km SE of Willowmore, Cape Prov. Middle Stone age industry reported in cave sediment. Coll. and subm. 1969 by

K. Jolly, Cape Town. *Comment*: pretreated with acid only. Too young for Middle Stone age.

Pta-261. Hofmeyer, Cape Province
3020 ± 90
1070 B.C.
 $\delta C^{13} = -3.1\%$

Calcite crust on animal horn assoc. with fossil skull found near Hofmeyer (31° 39' S Lat, 25° 49' E Long), Cape Prov. Subm. 1969 by H. de Villiers and A. Hughes, Univ. of Witwatersrand, Johannesburg. *Comment*: since bone contains no collagen, secondary calcite crust date, only minimum for much older skull.

Pta-014. Robberg Cave D, Cape Province
1925 ± 33
A.D. 50
 $\delta C^{13} = +3.4\%$

Patella shell 90 cm below surface at back of Cave D, S side of Robberg Pen. (34° 06.5' S Lat, 23° 24.5' E Long), near Cape Seal, Plettenberg Bay, Cape Prov. Four shells found with painted burial stone on human skeleton. Coll. 1917 by W. G. Sharples; subm. 1969 by J. Rudner, S. African Mus., Cape Town. *Comment*: pretreated with acid. Date of 2285 ± 105 B.P. (GX-1397) for shells found with painted burial stone at Klasies R. Mouth (Singer, 1969).

Lower Numas Cave series, SW Africa

Cave with rock paintings in Lower Numas Ravine (21° 08' S Lat, 14° 26' E Long), Brandberg, Omaruru dist., SW Africa. Testhole revealed fine Wilton industry without pottery (Rudner, 1957). Samples coll. and subm. 1969 by J. Rudner.

Pta-178. Lower Numas Cave 1
2890 ± 65
940 B.C.
 $\delta C^{13} = -24.6\%$

Charcoal from hearth 7 cm below surface in testhole.

Pta-179. Lower Numas Cave 2
2950 ± 65
1000 B.C.
 $\delta C^{13} = -22.0\%$

Charcoal from hearth 15 cm below surface in testhole.

General Comment: both samples pretreated with acid and alkali. Another date from Brandberg for Wilton industry with copper beads and pottery in Numas Entrance shelter is SR-46: 870 ± 100 (MacCalman, 1965). See also Pta-177, below.

Pta-177. Numas Plateau, SW Africa
265 ± 50
A.D. 1685
 $\delta C^{13} = -23.7\%$

Charcoal from fireplace covered with stone cairn, below so-called Okapo frieze, on Numas Plateau (21° 08' S Lat, 14° 30' E Long; alt 2250 m), Brandberg, Omaruru dist., SW Africa. Coll. and subm. 1969 by J. Rudner. Potsherds of Bergdama or Hottentot type found in ash. *Comment*: pretreated with acid and alkali.

Pta-212. Benfica, Angola**1810 ± 50****A.D. 140** $\delta C^{13} = -22.8\%$

Charcoal, 35 to 40 cm deep, from Strandloper kitchen midden near coast at Benfica, 17 km S of Luanda (8° 50' S Lat, 13° 15' E Long), Angola. Layer also contained shells, bones, and pottery (Dos Santos and Ervedosa, 1970). Coll. and subm. 1970 by J. R. Dos Santos, Jr., Univ. of Luanda, Angola. *Comment:* pretreated with acid and alkali. This early date for pottery on Angolan coast concurs with early pottery tradition in Zambia.

Mungo series, Angola

Rock shelter of Caninguiri, adm. of Mungo (11° 57' S Lat, 16° 28' E Long), Nova Lisboa dist., Angola, contains ca. 2 m sediment with Wilton type industry and rock paintings. Samples coll. and subm. 1970 by J. R. Dos Santos, Jr.

Pta-238. Mungo 3**7840 ± 80****5890 B.C.** $\delta C^{13} = -25.4\%$

Charcoal from 85 to 100 cm depth.

Pta-239. Mungo 5**9670 ± 90****7720 B.C.**

Charcoal from 160 to 196 cm depth.

Pta-240. Mungo 6**10,410 ± 90****8460 B.C.** $\delta C^{13} = -25.3\%$

Charcoal from 196 to 220 cm depth.

General Comment: all samples pretreated with acid and alkali. Dates comparable with other early Later Stone age dates in Angola, e.g., UCLA-172: 12,970 ± 250 B.P. and UCLA-167: 6830 ± 200 B.P. (R., 1963, v. 5, p. 17).

*B. Iron Age of Southern Africa***Pta-136. Klipriviersberg 4, Transvaal****227 ± 46****A.D. 1723** $\delta C^{13} = -23.1\%$

Further sample from lowest level of Iron age stone-wall settlement of Uitkomst culture at Klipriviersberg ca. 7 km S of Johannesburg (26° 11' S Lat, 28° 02' E Long), Transvaal (see R., 1967, v. 9, p. 148). Coll. and subm. 1969 by R. J. Mason, Univ. of Witwatersrand, Johannesburg. *Comment:* pretreated with acid only. Corrected most probable date derived from C¹⁴ calibration curve (Vogel, 1970) is A.D. 1645 in accordance with other dates for similar sites (R., 1970, v. 12, p. 465 ff.).

Pta-002. Ndumu, Zululand**1320 ± 40****A.D. 630** $\delta C^{13} = -12.8\%$

Charcoal found in and around iron furnace in Ndumu Game Reserve, junction of Usutu and Pongola Rivers (32° 20' E Long, 26° 51' S

Lat), Zululand (Dutton, 1970). Coll. 1968, subm. 1969 by P. Dutton and P. de Moor, Ndumu, Zululand. *Comment*: pretreated with acid and alkali. For similar early Iron age dates from Swaziland, see Castle Cavern series: GrN-5022: 1530 ± 30 ; GrN-5315: 1550 ± 30 (R., 1970, v. 12, p. 464).

900 \pm 40
A.D. 1050
 $\delta C^{13} = -26.9\%$

Pta-162. Blackburn Ridge, Natal

Charcoal from hearth 28 to 30 cm below surface, during systematic excavation of hut with NC₂ pottery at Blackburn village site (29° 41' S Lat, 31° 06' E Long), near Umhlanga Rocks, Natal. Coll. and subm. 1969 by O. Davies. *Comment*: pretreated with acid and alkali. Minimum date for arrival of Bantu S of Tugela R. Compare Ndumu, above.

1100 \pm 50
A.D. 850
 $\delta C^{13} = -25.4\%$

Pta-234. Kapako, SW Africa

Charcoal at 70 cm depth from test pit at Iron age site of Kapako (17° 55' S Lat, 19° 40' E Long), W of Runtu on Okavango R., SW Africa. Assoc. finds were potsherds, bone, isolated stone artifacts. Coll. 1968, subm. 1970 by B. Sandelowsky-Pendleton, State Mus., Windhoek, SW Africa. *Comment*: pretreated with acid and alkali. Compare Benfica, above, which has similar pottery.

290 \pm 45
A.D. 1660
 $\delta C^{13} = -24.9\%$

Pta-236. Vungu Vungu, SW Africa

Charcoal at 25 to 23 cm depth from Iron age site at Vungu Vungu (17° 53' S Lat, 19° 51' E Long), E of Runtu, on Okavango R., SW Africa. Potsherds, bone, glass beads, ostrich-eggshell beads, and shells found in assoc. Coll. 1969, subm. 1970 by B. Sandelowsky-Pendleton. *Comment*: pretreated with acid and alkali.

120 \pm 50
A.D. 1830
 $\delta C^{13} = -26.0\%$

Pta-235. Dikundu B 1973/E, SW Africa

Charcoal from bottom of iron-smelting furnace at 75 cm depth, Omuramba Dikundu (18° 06' S Lat, 21° 40' E Long), ca. 19 km SW of Andara on Okavango R., SW Africa. Coll. 1969, subm. 1970 by B. Sandelowsky-Pendleton. *Comment*: pretreated with acid and alkali.

C. Varia

1775 \pm 60
A.D. 175
 $\delta C^{13} = -24.4\%$

Pta-170. Egyptian Mummy

Piece from wrap of Egyptian mummy with naturalistic portrait of young man. Exact origin unknown. Now in Nat. Cult. Hist. Mus., Pretoria, South Africa. Subm. 1969 by E. van Rensburg, Nat. Cult. Hist. Mus., Pretoria. *Comment*: pretreated with acid only. Mummies with

mummy portraits from Fayum historically dated to 2nd and 3rd centuries A.D. (Zaloscer, 1961).

1090 \pm 50

Pta-227. Frauenchiemsee, Germany

A.D. 860

$\delta C^{13} = -28.2\text{‰}$

Outer tree rings of beam to left of entrance, S wall, of medieval building on Frauenchiemsee I. in Chiemsee (47° 52' N Lat, 12° 27' W Long), E of Rosenheim, Bavaria, Germany. Coll. and subm. 1970 by V. Miložić, Inst. f. Ur- u. Frühgeschichte, Univ. Heidelberg, Germany. *Comment:* pretreated with acid and alkali. Dates construction of ground floor of portal, considered built either between A.D. 850 and A.D. 880 or in 11th century. Correction of result with C¹⁴ calibration curve (Suess, 1970) could make date 60 yr later, still favoring earlier construction date.

III. GEOPHYSICAL SAMPLES

Pretoria series, South Africa

Atmospheric CO₂ coll. at Nat. Physical Research Lab. (25° 43' S Lat, 28° 21' E Long), 9 km E of Pretoria, South Africa, by slowly pumping air through 1.5 N NaOH solution.

Sample no.	Date			$\delta C^{13}(\text{‰})$	$\Delta(\text{‰})^*$
Pta-117	Oct.	7 – Oct.	10, 1968	–7.7	571 \pm 7
Pta-121	Nov.	4 – Nov.	18, 1968	–7.6	577 \pm 6
Pta-122	Dec.	9 – Dec.	23, 1968	(–7.5)**	561 \pm 7
Pta-120	Jan.	20 – Jan.	28, 1969	–8.2	560 \pm 8
Pta-123	Feb.	17 – Mar.	4, 1969	–7.0	558 \pm 7
Pta-119	Mar.	17 – Mar.	24, 1969	–7.2	541 \pm 6
Pta-131	Apr.	15 – Apr.	24, 1969	–7.3	542 \pm 7
Pta-130	July	15 – July	28, 1969	(–7.5)**	529 \pm 7
Pta-124	Sept.	9 – Oct.	13, 1969	–7.9	545 \pm 7
Pta-118	Oct.	28 – Nov.	23, 1969	–8.0	528 \pm 6
Pta-142	Jan.	12 – Jan.	26, 1970	–6.7	529 \pm 7
Pta-166	Feb.	19 – Feb.	26, 1970	–7.6	541 \pm 7
Pta-184	Mar.	9 – Mar.	17, 1970	–7.9	558 \pm 7
Pta-199	Apr.	13 – Apr.	20, 1970	–7.6	547 \pm 7
Pta-220	May	12 – May	17, 1970	–7.6	533 \pm 7
Pta-266	June	6 – June	22, 1970	–7.5	533 \pm 9
Pta-264	July	14 – July	20, 1970	–9.7	550 \pm 10
Pta-294	July	28 – Aug.	3, 1970	–8.6	517 \pm 9
Pta-332	Sept.	21 – Sept.	28, 1970	–7.8	532 \pm 8

* C¹⁴ surplus, adjusted to $\delta C^{13} = -25\text{‰}$

** C¹³ value estimated

Comment: no significant rise caused by French nuclear weapon tests in 1968 and 1970 at about same Lat (22°S) in Pacific Ocean. Development

of relative C^{14} content in air at Pretoria since 1954 shown in Fig. 2, lower curve. Based on samples measured at Heidelberg, Germany, Groningen, Netherlands (R., 1970, v. 12, p. 468), and Pretoria, above. For period 1966 to 1968, samples from Bariloche, Argentina (R., 1969, v. 11, p. 385) are also included. For comparison, curve for central Europe based mainly on measurements at Heidelberg also given (Münnich and Vogel, 1963; Münnich and Roether, 1967, extended by courtesy K. O. Münnich, Heidelberg). Slight seasonal fluctuation and gradual decrease in S hemisphere since 1965 is apparent.

Ocean Water series

Surface ocean water samples coll. on voyages of MS RSA from Cape Town to Sanae, Antarctica, in Jan. 1969 and Jan. 1970 by officers of Dept.

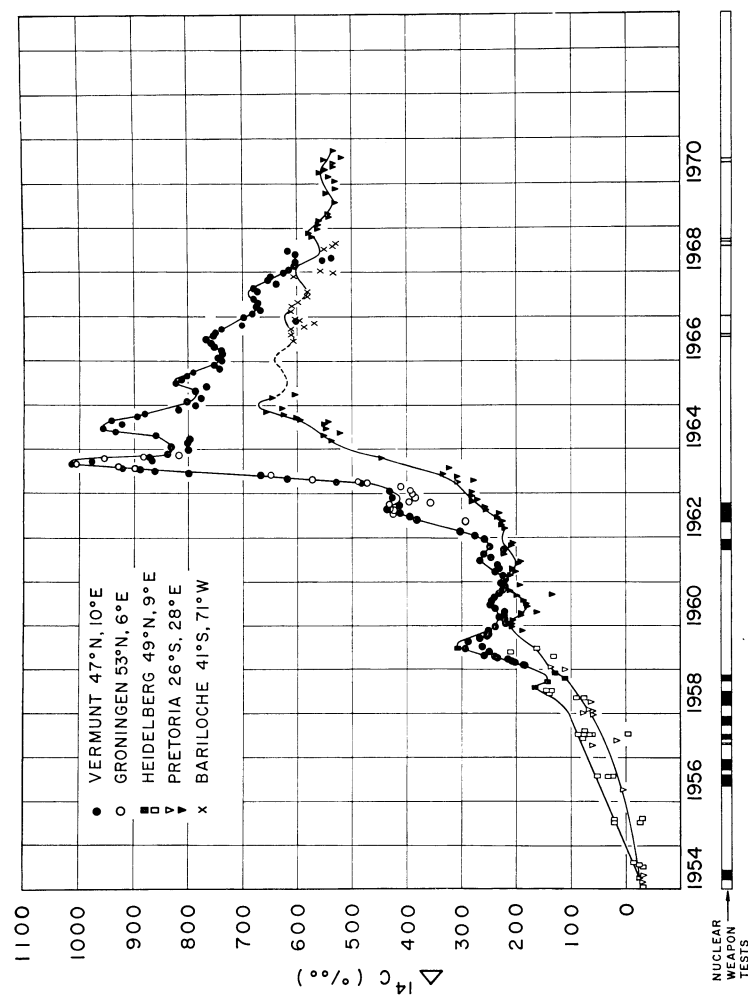


FIG. 2. Radiocarbon content of atmosphere at mid lats in S Hemisphere (lower curve) and N Hemisphere (upper curve). Results adjusted to $\delta C^{13} = -25\%$ according to Lamont normalization. Open squares and triangles are samples of plant material, the rest are direct measurements on atmospheric CO_2 . Upper curve based mainly on measurements at Heidelberg (see Comment on Pretoria series).

of Transport, Rep. of South Africa; and on voyage of MS Kaapland in Nov. 1969 and MS Stellenbosch in Jan./Feb. 1970 between Durban and Europe by J. C. Vogel, Sr. with generous help of Capts. Reiche and Rolff, officers, and crews. Inorganic carbon extracted by method described by Vogel (1967).

Sample no.	Date		Lat, Long	$\delta C^{13}(\text{‰})$	$C^{14}(\text{‰})$ modern)
Pta-075	Jan.	1969	40°S, ca. 15°E	-1.4	105.3±.6
Pta-074	Jan.	1969	50°S, ca. 15°E	-6.3	85.9±.5
Pta-073	Jan.	1961	60°S, ca. 10°E	-6.2	79.5±.4
Pta-071	Jan.	1969	65°S, ca. 0°	-6.3	72.2±.4
Pta-156	Nov. 16,	1969	29°18'S, 14°07'E	+1.4	115.7±.5
Pta-180	Nov. 18,	1969	19°11'S, 5°30'E	+2.0	111.7±.6
Pta-173	Nov. 20,	1969	8°20'S, 3°15'W	+1.9	112.8±.6
Pta-157	Nov. 21,	1969	2°31'S, 7°38'W	+1.1	112.6±.5
Pta-158	Nov. 22,	1969	3°16'N, 12°12'W	+2.0	120.3±.6
Pta-160	Nov. 24,	1969	15°55'N, 17°39'W	+1.8	111.9±.6
Pta-176	Nov. 26,	1969	29°26'N, 14°47'W	+2.0	119.8±.5
Pta-159	Nov. 27,	1969	35°38'N, 12°32'W	+2.0	117.0±.6
Pta-164	Nov. 29,	1969	47°35'N, 6°10'W	+1.5	116.1±.6
Pta-175	Jan. 1,	1970	30°01'N, 15°28'W	+1.6	119.6±.6
Pta-155	Feb. 4,	1970	34°08'S, 18°13'E	+1.1	103.5±.5
Pta-153	Feb. 5,	1970	34°35'S, 22°30'E	+1.2	108.5±.6
Pta-154	Feb. 9,	1970	32°54'S, 28°11'E	+2.0	108.3±.6
Pta-222	Jan.	1970	50°S; ca. 15°E	-6.0	80.8±.6
Pta-221	Jan.	1970	60°S; ca. 10°E	-7.1	69.7±.5
Pta-223	Jan.	1970	65°S; ca. 0°	-6.5	76.7±.6

Comment: for series coll. in 1967, see R., 1970, v. 12, p. 469. Unexpectedly low values between 50°S and 65°S indicate water not derived from Atlantic ocean deep water, but rather from Pacific-Antarctic basin. Low values in Atlantic ocean (Pta-160, Pta-155) due to upwelling near African coast. Otherwise low lats in S Atlantic uniform at +12‰ and N Atlantic at ca. +20‰, indicating a rise of 4‰ since mid 1967. As yet, no explanation for occasional higher values in S hemisphere (Pta-156).

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