[RADIOCARBON, VOL. 21, NO. 2, 1979, P. 203-256]

SCOTTISH UNIVERSITIES RESEARCH AND REACTOR CENTRE RADIOCARBON MEASUREMENTS III

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INTRODUCTION

Results reported here are for samples of geologic context. Throughout the period of these analyses, *viz*, 1973 through 1975, the preparation of samples and operation of counting systems remained essentially as described in Radiocarbon, 1973, v 15, p 554 to 565.

$\delta^{13}C$ is determined for all samples dated and these values are quoted at $\pm$ 0.5‰ (2σ) precision and relative to the PDB limestone standard.

Age calculation is based on the Lamont formulae using the Libby half-life (5568 years) and 95% of the isotopically corrected activity of NBS oxalic acid as the modern reference standard. Analytical confidence is expressed at the 1σ level and reflects a summation of those uncertainties incurred at each component stage in the physiochemical assay. Extremes of the experimental time-scale are defined as follows: 1) measured radiometric enrichment ($\delta^{14}C$) in the range 0 to $-40‰$ is interpreted as 'Modern', 2) measured sample activities indistinguishable from background at the 4σ confidence level are reported in infinite format, *ie*, > x years where x is calculated on the basis of $\delta^{14}C‰ = (-1000 + 4\sigma_{(\delta^{14}C)})$.

With the exception of groundwater and calcrete samples, the reported ages are normalized for isotopic fractionation relative to $-25‰$. Age values for the former sample types are calculated directly from $\delta^{14}C$ as quoted and with $\delta^{13}C$ also given for general information. It should be noted that in our previous date lists this policy was extended to marine shells as quasi-compensation for the 'apparent age' factor inherent in shells of European origin. It is now considered preferable to normalize shell activities relative to $-25‰$ PDB. Thus, ages reported for all samples of marine origin reflect a ^{14}C deficiency in direct comparison with the conventional land based time-scale. Geographic variation in the magnitude of this phenomenon must also be considered in archaeologic and geologic interpretation.

ACKNOWLEDGMENTS

Operation of the laboratory has continued under the aegis of the Natural Environment Research Council, and B F Miller, J I Service, and R Spence have provided excellent technical assistance.

We are grateful to those who have submitted samples, for their permission to report this work and for assistance in providing information essential to the satisfactory compilation of this date list.

SAMPLE DESCRIPTIONS

A. Antarctica

SRR-27. Signy Island, South Orkney Islands **Modern**
$\delta^{14}C = -26.3 \pm 3.8‰$
$\delta^{13}C = -22.5‰$

Moss peat from base of bank, ca 30cm deep, exposed by retreat of snow bank below Jane Peak, Signy I. (60° 40′ S, 45° 40′ W). Coll 1970 by N J Collins; subm by R J Adie, British Antarctic Survey.

SRR-28. Elephant Island, South Shetland Islands **1520 ± 40**
$\delta^{13}C = -23.2‰$

Moss peat from eroded bank on SE slope N of Walker Point, Elephant I. (61° 10′ S, 55° 14′ W). Coll 1970 by R M O'Brien, Joint Services Expedition; subm by R J Adie.

SRR-29. Grytviken, South Georgia **720 ± 60**
$\delta^{13}C = -25.0‰$

Polytrichum alpestre peat from base of vegetation hummock, ca 100cm high, S of Grytviken Whaling Sta, King Edward Cove, South Georgia (54° 17′ S, 36° 31′ W). Coll 1971 by R I L Smith; subm by R J Adie.

Cumberland East Bay series, South Georgia

Peat from profiles taken on plain below gun hut SW of King Edward Cove, Cumberland East Bay, South Georgia (54° 17′ S, 36° 29′ W). Site consists of a *Rostkovia magellanica* bog with scattered patches of *Sphagnum fibriatum,* surface slopes to the sea where it is fringed by a narrow zone of *Poa flabellata*. Coll 1961 by S W Greene; subm by R J Adie.

SRR-30. Cumberland East Bay, 38cm depth **390 ± 70**
$\delta^{13}C = -22.7‰$

Base of *Sphagnum* peat layer, Profile No. 3 (Greene 3616).

SRR-31. Cumberland East Bay, 102cm depth **2340 ± 50**
$\delta^{13}C = -19.2‰$

Rostkovia moss peat, Profile No. 3 (Greene 3620).

SRR-32. Cumberland East Bay, 38cm depth **Modern**
$\delta^{14}C = -30.2 \pm 4.4‰$
$\delta^{13}C = -26.2‰$

Base of *Sphagnum* peat layer, Profile No. 6 (Greene 3633).

General Comment (SWG): see Sphagnum Valley, Cumberland West Bay series.

Husvik series, South Georgia

Sphagnum peat from profiles taken within a single patch of living *Sphagnum fimbriatum* (ca 12.2 × 21m area) in an area of *Rostkovia magellanica* bog W of graveyard in valley running SW from Husvik Whaling

Sta, Stromness Bay, South Georgia (54° 10′ S, 36° 42′ W). Coll 1961 by S W Greene; subm by R J Adie.

SRR-33. Husvik, 51cm depth **660 ± 70**
$\delta^{13}C = -26.3‰$

Base of *Sphagnum* layer in Profile No. 15 (Greene 3676).

SRR-34. Husvik, 76cm depth **1090 ± 60**
$\delta^{13}C = -25.8‰$

Rostkovia moss peat in Profile No. 15 (Greene 3674).

SRR-35. Husvik, 38cm depth **560 ± 70**
$\delta^{13}C = -24.3‰$

Base of *Sphagnum* peat layer in Profile No. 16 (Greene 3682).

SRR-36. Stromness Bay, 51cm depth **1080 ± 70**
$\delta^{13}C = -25.5‰$

Base of *Sphagnum* peat layer in Profile No. 17 (Greene 3686).

General Comment (SWG): see Sphagnum Valley, Cumberland West Bay series.

Stromness Harbour series, South Georgia

Peat from profile (No. 18) taken in center of carpet of living *Sphagnum fimbriatum* (ca 22.9 × 25.9m area) in *Rostkovia magellanica* bog N of whaling sta on W shore of Stromness Harbour, Stromness Bay, South Georgia (54° 8′ S, 36° 42′ W). Coll 1961 by S W Greene; subm by R J Adie.

SRR-37. Stromness Harbour, 38cm depth **Modern**
$\delta^{14}C = -35.0 \pm 6.0‰$
$\delta^{13}C = -24.1‰$

Base of *Sphagnum* peat layer (Greene 3692).

SRR-38. Stromness Harbour, 64cm depth **580 ± 50**
$\delta^{13}C = -24.2‰$

General Comment (SWG): see Sphagnum Valley, Cumberland West Bay series.

Sphagnum Valley, Cumberland West Bay series, South Georgia

Peat from profiles taken in *Rostkovia magellanica* bog in Sphagnum Valley sited behind shore at Low Point SE of Cumberland West Bay, South Georgia (54° 16′ S, 36° 35′ W). Profiles 19 and 21 overlain by a surface layer of *Sphagnum fimbriatum,* Profile 20 lacked such a layer. Coll 1961 by S W Greene; subm by R J Adie.

SRR-39. Sphagnum Valley, 38cm depth **440 ± 50**
$\delta^{13}C = -24.8‰$

Base of uppermost *Sphagnum* peat layer in Profile No. 19 (Greene 3698).

SRR-40. Sphagnum Valley, 64cm depth **870 ± 50**
$\delta^{13}C = -25.8‰$

Base of buried *Sphagnum* peat layer in Profile No. 19 (Greene 3696).

SRR-41. Sphagnum Valley, 89cm depth **1550 ± 50**
$\delta^{13}C = -27.4‰$

Top of a buried *Sphagnum* peat layer in Profile No. 19 (Greene 3706).

SRR-42. Sphagnum Valley, 102cm depth **1760 ± 50**
$\delta^{13}C = -28.8‰$

Base of a buried *Sphagnum* peat layer in Profile No. 19 (Greene 3705).

SRR-43. Sphagnum Valley, 152cm depth **2380 ± 50**
$\delta^{13}C = -29.0‰$

Rostkovia—moss peat in Profile No. 19 (Greene 3701). Sample from 140 to 152cm (Greene 3701 plus 3702) previously dated (2500 ± 800; UCLA-658C).

SRR-44. Sphagnum Valley, 38cm depth **720 ± 60**
$\delta^{13}C = -25.2‰$

Base of a buried *Sphagnum* peat layer in Profile No. 20 (Greene 3712).

SRR-45. Sphagnum Valley, 64cm depth **1560 ± 60**
$\delta^{13}C = -29.9‰$

Rostkovia—moss peat overlying layer of buried *Sphagnum* peat in Profile No. 20 (Greene 3710).

SRR-46. Sphagnum Valley, 76cm depth **1960 ± 60**
$\delta^{13}C = -26.0‰$

Base of buried *Sphagnum* peat layer in Profile No. 20 (Greene 3709).

SRR-47. Sphagnum Valley, 64cm depth **1890 ± 70**
$\delta^{13}C = -24.8‰$

Base of buried *Sphagnum* peat layer in Profile No. 21 (Greene 3720).

SRR-48. Sphagnum Valley, 127cm depth **5190 ± 100**
$\delta^{13}C = -22.9‰$

Rostkovia—moss peat in Profile No. 21 (Greene 3715). Sample from 102 to 115cm depth in this profile (Greene 3716, -3717) previously dated (6500 ± 500; ICLA-658B).

General Comment (SWG): while none of these dates are for base of whole peat layer, it appears that South Georgia has been, in part, well vegetated for at least 6500 yr. Dates for most complete profiles clarify steady accumulation of peat on South Georgia, with little evidence of further compression below depth of ca 50cm.

SRR-49. Nordenskjold glacier **1540 ± 70**
$\delta^{13}C = -18.4‰$

Collagen isolated from whale bone embedded in surface near crest of moraine 4m high, 400m in front of Nordenskjold glacier and 80m landward of present beach, on W side of Cumberland East Bay, South Georgia (54° 17′ S, 36° 29′ W). Coll 1971 by C M Clapperton; subm by R J Adie.

SRR-512. Cape Hansen Coronation Island **Modern**
$\delta^{14}C = -17.0 \pm 7.5‰$
$\delta^{13}C = -23.1‰$

Moss peat (*Chorisodontium aciphyllum*) from base of bank 10cm thick re-exposed by retreat of snow cover at Cape Hansen, Coronation I., South Orkney Is. (60° 39′ S, 45° 32′ W). Sample represents basal 3.5cm of peat overlying mineral soil. Coll 1974 by J H C Fenton; subm by N J Collins, British Antarctic Survey.

Signy Island series, South Orkney Islands

Moss peat (mainly *Chorisodontium aciphyllum* with some *Polytrichum alpestre*) from persistent snowfield, extension of main ice cap, E of Rusty Bluff, Signy I., South Orkney Is. (60° 40′ S, 45° 40′ W). Coll 1974 by J H C Fenton; subm by N J Collins.

SRR-513. Signy Island **Modern**
$\delta^{14}C = -24.3 \pm 6.6‰$
$\delta^{13}C = -27.2‰$

Upper layer of deposit ca 70cm thick buried under 65cm of ice.

SRR-514. Signy Island **Modern**
$\delta^{14}C = -6.0 \pm 8.3‰$
$\delta^{13}C = -23.6‰$

Base of deposit (*cf* SRR-513) but may not be *in situ* since all moss shoots in this layer point downwards.

SRR-515. Signy Island **Modern**
$\delta^{14}C = -13.9 \pm 8.5‰$
$\delta^{13}C = -25.1‰$

Sample from bank of peat wedged between ice at margin of snowfield and rock outcrop.

Cooper Bay series, South Georgia

Peat from low ground between moraine ridges at Cooper Bay, South Georgia (54° 47′ S, 35° 48′ W). Coll 1974 by P Stone; subm by R J Adie.

SRR-516. Cooper Bay (M671P 1) **350 ± 50**
$\delta^{13}C = -27.8‰$

SRR-517. Cooper Bay (M671P 7) **105.9 ± 0.7% modern**
$\delta^{13}C = -27.8‰$

SRR-518. Cooper Bay (M671P 10) 100.4 ± 0.6% modern
$\delta^{13}C = -28.3‰$

General Comment (PS): SRR-517 and -518 clearly postdate AD 1954 from presence of 'bomb ^{14}C'. All specimens coll from moraine ridges believed to be ca 6000 yr old. No significance relative to absolute age of glacial advance. But deepest peat was always coll; why was there no peat formation prior to 1600? Possible climatic change or even introduction into that area of peat forming mosses.

SRR-519. Wirik Bay, South Georgia 880 ± 40
$\delta^{13}C = -20.5‰$

Collagen isolated from bone of elephant seal buried in moraine Wirik Bay, South Georgia (54° 45′ S, 35° 51′ W). Coll 1974 by P Stone; subm by R J Adie. *Comment* (PS): date too young to avoid large error from falsely old reading. Much older than expected but probably reflects 'apparent age' of marine carbon sources in this geographic region.

SRR-520. Will Point, Royal Bay, South Georgia 2370 ± 40
$\delta^{13}C = -26.1‰$

Unid animal remains from floor of sea cave assoc with emerged beach at Will Point, Royal Bay, South Georgia (54° 33′ S, 36° 1′ W). Coll 1973 by P Stone; subm by R J Adie. *Comment* (PS): sea cave is ca 8m asl and assoc with emerged beach at 1.5m asl. This date is useful in measuring rate of sea level change.

Sphagnum Valley series, South Georgia

Peat from 2 bog sites, ca 500m apart, with layered stratigraphy overlying glacial till in Sphagnum Valley, Cumberland West Bay, South Georgia (54° 16′ S, 36° 35′ W). Coll 1973 by C J Barrow; subm by R I L Smith, British Antarctic Survey, Bot Sec.

SRR-578. Sphagnum Valley, 222.5cm depth 6650 ± 120
$\delta^{13}C = -27.9‰$

Clay-rich peat, with remains of *Juncus,* bryophytes, grasses from freshly cut sec.

SRR-579. Sphagnum Valley, 232.5cm depth 4000 ± 90
$\delta^{13}C = -28.8‰$

Clay rich peat, origins of plant remains obscure, from sec of bedded peats exposed by stream erosion.

General Comment (JCB/RILS): Sphagnum Valley is a broad well-vegetated valley with extensive bogs (dominated by *Rostkovia magellanica, Juncus Scheuchzerioides* and bryophytes) and overlying deep deposits of peat. Sample SRR-578 was taken from base of continuous layer of organic material in *Rostkovia*-bryophyte bog at ca 50m alt. Palynologic analysis of this level revealed abundance of pollen, *Acaena* spp, (predominantly *Acaena magellanica*) and *Gramineae* and lesser quantities of *Galium antarcticum, Colobanthus* spp, spores of *Conostomum pentastichum,* and

an ascomycetous fungus believed to be parasitic on the rush. Grains of *Nothofagus* sp, of South American origin, were also isolated. Absence of juncaceous pollen is attributed to its poor preservation qualities. Small quantities of organic matter occurred in clay at 317.5cm in same profile, while organic inconclusions were visible in clay deposits at 377cm in another profile ca 15m away. Sample SRR-579 came from case of continuous layer of peat in wet bog dominated by *Acaena magellanica* with some *Rostkovia* and bryophytes ca 500m from SRR-578. It lay nearer shore close to upper emerged beach system of Cumberland West Bay coastline at ca 6m alt. Palynologic analysis of this level provided abundance of pollen, *Acaena* spp and *Gramineae,* smaller amounts of *Galium antarcticum, Colobanthus* spp, and spores of *Conostomum pentastichum.*

Discrepancy in age between the 2 samples from approx same depth may be because emerged beach area of SRR-579 was still unvegetated shoreline long after SRR-578 bog complex was established. Thus, samples from corresponding levels at these sites are likely to be much younger at site where peat accumulation commenced much later.

'Gun Hut Valley' series, South Georgia

Clayey peat from valley floor deposit at ca 25 to 30m alt in 'Gun Hut Valley', South Georgia (54° 33′ S, 36° 28′ W). 'Gun Hut Valley' is given in inverted commas as it is not an official place name but a term in common useage. An ex-wartime gun hut is at seaward end of valley. Coll 1973 by C J Barrow; subm by R I L Smith.

SRR-580. 'Gun Hut Valley', 50cm depth **4850 ± 210**
$\delta^{13}C = -28.8‰$

Peat in sec exposed by meltwater stream erosion.

SRR-581. 'Gun Hut Valley', 105cm depth **2940 ± 90**
$\delta^{13}C = -28.2‰$

Peat in sec exposed by stream erosion.

SRR-582. 'Gun Hut Valley', 160cm depth **8540 ± 70**
$\delta^{13}C = -29.9‰$

Peat from base of deposit overlying glacial debris, sec exposed by subsidence.

SRR-736. 'Gun Hut Valley', 255 to 260cm depth **9490 ± 370**
$\delta^{13}C = -29.7‰$

Clayey peat at base of compacted profile, exposed by stream erosion, and overlying stone/clay deposit at 265cm depth.

General Comment (CJB/RILS): 'Gun Hut Valley' is small broad valley with extensive bogs dominated by *Rostkovia magellanica, Juncus scheuchzerioides* and bryophytes, overlying deep deposits of peat. Sites lay between 300 and 500m from sea at alt ca 25 to 30m. SRR-580 and -582 were ca 15m apart and SRR-581 was ca 200m up valley from these. SRR-736 was from base of same sec as SRR-580, samples from other 2 sites was from lowest level of organic matter in their profiles.

Sites SRR-580 and -582 appeared similar both in composition and structure of peat and depth-age relationship. These sites were well-drained in comparison with SRR-581. Peat at former 2 sites is composed of *Rostkovia* and tall turf-forming mosses *Chorisodontium aciphyllum, Dicranoloma* spp and *Polytrichum* spp, all of which accumulates peat relatively rapidly, whereas deposit at SRR-581 is formed mainly by *Juncus, Tortula robusta,* and some *Acaena magellanica* species which develop peat much more slowly. Thus samples taken from corresponding levels at each site are likely to be much older at latter site. Peat at level SRR-736 is rich in fine plant material, particularly bryophyte remains. Pollen is sparse and well-preserved, but not so sparse that it is likely to have come from South America. Preliminary palynologic analysis of this level has revealed abundant grains of *Acaena* (probably mainly *Acaena magellanica* although *Acaena tenera* has been tentatively id also) and small quantities of *Gramineae, Callitriche antarctica,* and moss *Conostomum pentastichum*; fungal material, one species of desmid, remains of mites, and possibly copepods have also been id. This is deepest and oldest sample yet analyzed from South Georgia and date ties in well with estimated retreat of last major glaciation on the island some 10,000 yr ago.

SRR-583. Snipe Flats Camp, East Falkland Islands **9160 ± 110**
$\delta^{13}C = -28.6‰$

Clay rich peat containing remains of *Juncus,* grasses, and *bryophytes* from ca 28cm above base of ca 2.6m thick deposit overlying bedrock on floor of upland valley, alt 183m OD, at Snipe Flats Camp, East Falkland Is. (51° 0′ S, 59° 5′ W). Coll 1973 by G J Barrow; subm by R I L Smith. *Comment* (CJB/RILS): site is typical of undisturbed upland peats of Falkland Is. Slightly deeper deposits may occur in some valley bogs. Present vegetation at site comprised dwarf shrubs, grasses, rushes, sedges, and bryophytes.

SRR-584. Ocean Harbour, South Georgia **3590 ± 100**
$\delta^{13}C = -28.8‰$

Clay rich peat containing *Sphagnum fimbricatum,* other bryophytes, and *Juncus scheuchzerioides,* from 143cm depth in valley-side deposit at ca 6m alt Ocean Harbour, South Georgia (54° 20′ S, 36° 16′ W). Coll 1973 by C J Barrow; subm by R I L Smith. *Comment* (CJB/RILS): sample was from lowest level of peat in bog complex of similar floristic composition and alt to that from which SRR-579 was derived. Age-depth relationship of 2 sites is also comparable.

SRR-585. South Anenkov Island, South Georgia **1010 ± 160**
$\delta^{13}C = -27.4‰$

Peat of grass origin (*Poa flabellata*) from base of tussock, ca 150cm high, overlying rounded pebbles on bank of stream close to 1972/3 Geology Field Camp, at ca 20m alt, South Annenkov I., South Georgia (54° 29′ S, 37° 5′ W). Coll 1972 by C J Barrow; subm by R I L Smith. *Comment* (CJB/RILS): sample was taken from base of tall organic 'pedestal' formed

by accumulation of dead foliage, litter, and living and dead roots of tall tussock grass, *Poa flabellata*. In comparison with peat accumulation in bogs, *Poa flabellata* forms relatively deep deposits of loose fibrous organic matter more rapidly than rushes and bryophytes. Consequently, comparatively young age of this deep sample should not be compared with samples from similar depths taken from valley bogs.

SRR-737. St Andrew's Bay, South Georgia **850 ± 50**

$\delta^{13}C = -20.5‰$

Collagen isolated from striated whale bone exposed by stream erosion of readvance moraine at St Andrew's Bay South Georgia (54° 28′ S, 36° 10′ W). Coll 1975 by D E Sudgen and C M Clapperton, Univ Aberdeen; subm on behalf of British Antarctic Survey. *Comment* (CMC): in conjunction with SRR-738, this material should date episode of glacial advance which is thought to relate to 'Little Ice Age' of the N hemisphere. Therefore ^{14}C age appears to be 650 to 800 yr too old. Discrepancy may well result from 'apparent age' of marine carbon in region.

SRR-738. Heaney Glacier, South Georgia **Modern**

$\delta^{14}C = -35.3 \pm 5.3‰$

$\delta^{13}C = -33.4‰$

Top 1cm thickness of peat layer overlain by ca 60cm till at 60m inside readvance limit of Heaney Glacier, South Georgia (54° 26′ S, 36° 11′ W). Coll 1975 and subm by D E Sudgen and C M Clapperton. *Comment* (CMC): fits with date of proposed glacial advance, *viz,* AD 1750 to AD 1890.

SRR-739. Doris Bay, South Georgia **2010 ± 50**

$\delta^{13}C = -21.3‰$

Peat from basal deposit in kettle hole at Doris Bay, South Georgia (54° 29′ S, 36° 9′ W). Coll 1975 and subm by D E Sudgen and C M Clapperton. *Comment* (CMC): kettle hole is in complex system of recessional moraines which relate to much more extensive glacial-climatic event than 'Little Ice Age'. Date provides useful min age for event.

Sub-Antarctica (Modern) series

20th century materials coll from various locations in South Georgia in an attempt to assess 'apparent age' as determined by marine food chain in region of Sub-Anatarctic (Rafter & O'Brien, 1972). Coll 1975 by C M Clapperton and D E Sudgen.

SRR-740. Hound Bay, South Georgia

(a) 'outer' fraction **690 ± 40**

$\delta^{13}C = +1.1‰$

(b) 'inner' fraction **760 ± 40**

$\delta^{13}C = +0.8‰$

Shell ca 0 to 20 yr old, from High Water Mark on Shingle beach at Hound Bay, South Georgia (54° 23′ S, 36° 15′ W). Prior to ^{14}C assay, outermost 25‰ of shells was discarded by scrubbing and acid leaching.

'Outer' and 'inner' fractions of leached shells were isolated via controlled hydrolysis using 2M HCl.

SRR-741. St Andrew's Bay, South Georgia **113.5 ± 0.5% modern**
$\delta^{13}C = -14.0‰$

Kelp growing in intertidal zone at St Andrew's Bay, South Georgia (54° 28′ S, 36° 9′ W).

SRR-742. St Andrew's Bay, South Georgia **790 ± 40**
$\delta^{13}C = -19.5‰$

Collagen isolated from bone of decomposing elephant seal carcass on beach at St Andrew's Bay, South Georgia (54° 28′ S, 36° 10′ W).

SRR-743. St Andrew's Bay, South Georgia

(a) 'outer' fraction **107.6 ± 0.5% modern**
$\delta^{13}C = +2.2‰$

(b) 'inner' fraction **106.0 ± 0.5% modern**
$\delta^{13}C = +1.9‰$

Limpet shells coll live from intertidal zone at St Andrew's Bay, South Georgia (54° 28′ S, 36° 9′ W). Flesh discarded on coll, shells pretreated as for SRR-740.

SRR-744. Grytriken Whaling Sta, South Georgia **970 ± 40**
$\delta^{13}C = -19.0‰$

Collagen isolated from whale rib in factory dump above High Water Mark and S of former Grytriken Whaling Sta, South Georgia (54° 16′ S, 36° 30′ W). Bone ca 12 to 50 yr old on basis of recorded operations at Grytriken.

*General Comment*s indicate a natural radiocarbon deficiency equivalent to between 800 and 1000 yr in carbon primarily assimilated from coastal waters. By 1975 this effect had been more than compensated in intertidal zone through influence of 'bomb ^{14}C'.

B. England

Rusland Moss series, England

Peat coll at several adjacent sites within emerged bog complex, Rusland Moss, Lancashire, England (54° 17′ N, 3° 1′ W, Natl Grid Ref SD 334 887). Site E is near lateral margin, Site F near upper margin and Site G near crown of emerged bog. Site H is in an area of bog where deepest deposit of *Sphagnum* occurs. Sampled from cleaned faces of old peat cuttings or by coring with a 6m piston borer; quoted depths relate to present bog surface. Coll 1972 and subm by W Dickinson and D D Bartley, Univ Leeds.

SRR-120. Site E, 50cm depth **1510 ± 50**
$\delta^{13}C = -25.5‰$

Unhumified *Sphagnum imbricatum* from recurrence surface. Sample from this level previously dated (GaK-2869; 2560 ± 100 and subsequently GaK-2869(b); 1540 ± 100).

SRR-220. Site E, 97cm depth **2400 ± 50**
$\delta^{13}C = -26.3‰$

Unhumified *Sphagnum plumulosum*. Sample from this level previously dated (GaK-2868; 3100 ± 120).

SRR-121. Site F, 62.5cm depth **1540 ± 50**
$\delta^{13}C = -26.7‰$

Mainly unhumified *Sphagnum imbricatum* from recurrence surface.

SRR-122. Site F, 107cm depth **2330 ± 50**
$\delta^{13}C = -25.1‰$

Lowest unhumified *Sphagnum imbricatum,* indicates initiation of raised bog conditions at site. Sample at this level previously dated (GaK-3703; 2100 ± 90).

SRR-123. Site G, 89cm depth **1550 ± 60**
$\delta^{13}C = -26.1‰$

Eriophorum vaginatum with *Sphagnum imbricatum* from possible recurrence surface.

SRR-124. Site H, 21cm depth **810 ± 50**
$\delta^{13}C = -25.8‰$

Sphagnum imbricatum. Sample from this level previously dated (GaK-3701; 880 ± 80).

SRR-125. Site H, 66 to 69cm depth **1360 ± 60**
$\delta^{13}C = -24.8‰$

Sphagnum imbricatum with little *Vaccinum oxycoccos*. Sample from this level previously dated (GaK-3702; 1390 ± 100).

SRR-126. Site H, 107 to 110cm depth **1960 ± 50**
$\delta^{13}C = -25.2‰$

Sphagnum imbricatum with some remains of *Ericaceous* plants.

SRR-127. Site H, 151cm depth **2370 ± 60**
$\delta^{13}C = -26.2‰$

Humified band ca 2 to 3cm thick containing *Sphagnum imbricatum, Eriophorum vaginatum,* and *Ericaceous* species.

SRR-128. Site H, 208 to 211cm depth **2690 ± 50**
$\delta^{13}C = -25.9‰$

Sphagnum imbricatum from lowest unhumified peat at site. Sample from this level previously dated (GaK-3169; 3060 ± 200).

General Comment (WD): SRR-122, -220, and -128 show that initiation of emerged bog conditions was not synchronous throughout area but ranged from ca 2686 BP to 2329 BP. Ages SRR-120, -121, and -123 show that, in Rusland Moss, major recurrence surface, previously recognized through stratigraphic studies and pollen analysis, does seem to be synchronous horizon and can be correlated with Granlund's RYII, formed as result of widespread deterioration of climate at ca AD 400.

SRR-73. Abbot's Cliff, Folkestone **Modern**

$\delta^{14}C = -6.2 + 8.4‰$

$\delta^{13}C = -24.8‰$

Wood charcoal from seam, 0.08m thick at ca 2.1m below present ground surface, Abbot's Cliff, Folkestone, England (51° 6′ N, 1° 15′ E, Natl Grid Ref TR 276 390). Coll 1972 by P Gostelow and J N Hutchinson, Imperial Coll, London; subm by Inst Geol Sci, London. *Comment* (JNH): trial pits dug to explore origin of one of line of shallow craters running approx parallel with cliff line. Dates indicate that craters are artificial in origin, their purpose remains unclear.

Beesands series, England

Compacted phragmites peat in Borehole No. 4 on landward side of high water level at Beesands, Start Bay, S Devon, England (50° 20′ N, 3° 35′ W, Natl Grid Ref 821 410). Peat deposit, ca 0.3m thick, rests on silty clay and is overlain by ca 10m shingle. Quoted sample depths relate to Ordinance Datum. Coll 1973 and subm by M W L Blackley, NERC Unit Coastal Sedimentation, Somerset.

SRR-164. Beesands, −4.32m OD **4300 ± 50**

$\delta^{13}C = -27.3‰$

Sample from upper 10cm of peat deposit.

SRR-165. Beesands, −4.62m OD **4770 ± 50**

$\delta^{13}C = -27.1‰$

Sample from basal 10cm of peat deposit.

SRR-237. Hallsands 70VC **8110 ± 60**

$\delta^{13}C = -27.9‰$

Compacted peat with compressed wood fragments in off-shore borehole, Hallsands, S Devon, England (50° 20′ N, 3° 35′ W, Natl Grid Ref 825 390). Sample coll with Vibro-corer, is from uppermost 10cm of peat deposit of unknown thickness, overlain by ca 1.2m blue clay and mixture of sand, silts, and clays. Coll 1973 and subm by M W L Blackley.

SRR-273. Start Bay **Modern**

$\delta^{14}C = -2.2 + 1.9‰$

$\delta^{13}C = +0.9‰$

Marine shell (*Acanthocardia echinata*) in medium-grained sand at 23cm depth in sea bed Start Bay, S Devon, England (50° 20′ N, 3° 35′ W). Coll 1972 and subm by B J Lees, Inst Oceanog Sci, Taunton.

SRR-317. North Hallsands **1680 ± 50**

$\delta^{13}C = -29.3‰$

Peat at ca −1m OD and overlain by marine shingle North Hallsands, Devon, England (50° 14′ N, 3° 39′ W, Natl Grid Ref 818 389). Coll 1974 and subm by M W L Blackley. *Comment* (MWLB): date confirms geomorphologic and geologic evidence that peat accumulated in brackish coastal lagoon enclosed from sea by shingle barrier.

SRR-318. Blackpool Beach **2540 ± 70**
$\delta^{13}C = -26.1‰$

Cellulose fraction isolated from wood of tree stump, *in situ,* embedded in clay and overlain by marine gravels, Blackpool beach, S Devon, England (50° 19′ N, 3° 36′ W, Natl Grid Ref SX 855 478). Coll 1974 and subm by H Osmaston, Univ Bristol. *Comment* (HO): sample is from remains of woodland at between +1 to −1m OD, *ie,* well below present high tide level. Sea level must have been significantly lower at 2500 BP.

SW Approaches series, England

Superficial calcareous ooze on sea floor of Continental slope, SW Approaches, England. All carbonate in samples discarded by acid digestion prior to ^{14}C assay. Coll 1972 and subm by D Hamilton, Univ Bristol.

SRR-185. SW Approaches **>43,500**
$\delta^{14}C = -999.7 \pm 1.1‰$

Sediment under 841m water column (48° 43′ N, 10° 37′ W).

SRR-186. SW Approaches **23,090 +1550 −1300**

Sediment under 2121m water column (48° 30′ N, 10° 21′ W).

Celtic Sea series, England

Organic detritus in gray clay sediment coll by gravity corer from floor of Celtic Sea, England. All carbonate in samples discarded by acid digestion prior to ^{14}C assay. Coll 1974 and subm by D Hamilton.

SRR-640. Celtic Sea SB 2332 **24,370 +1050 − 930**
$\delta^{13}C = -24.9‰$

Sample at ca 36m depth in sea bed (50° 39′ N, 7° 59′ W).

SRR-641. Celtic Sea SB 2328 **33,580 +1270 −2000**
$\delta^{13}C = -25.2‰$

Sample at ca 4cm depth in seabed (50° 37′ N, 8° 14′ W).

SRR-616. Ravenswood Farm, Crowthorne **10,980 ± 130**
$\delta^{13}C = -28.2‰$

Peat from ca 0.85m depth in borehole (LB A4) at Ravenswood Farm, Crowthorne, England (51° 23′ N, 0° 49′ W, Natl Grid Ref SU 8255 6497). Peat band below alluvium overlies Bagshot Sands. Coll 1974 and subm by M R Clarke, Inst Geol Sci, London.

SRR-617. Heath Lake, Crowthorne **10,400 ± 60**
$\delta^{13}C = -29.6‰$

Peat from ca 0.5m depth in borehole (LB A5) at Heath Lake, Crowthorne, England (51° 23′ N, 0° 49′ W, Natl Grid Ref SU 8227 6525). Stratified as SRR-616. Coll 1974 and subm by M R Clarke. *Comment* (MRC): with SRR-616, shows that low lying, ca 61m OD, Plateau Deposits of area (River Terrace Deposits) were laid down and subsequently dissected prior to 9000 BP by aggrading river system.

Mendlesham series, England

Chalk groundwater pumped from IGS borehole (No. 190/594) Mendlesham, Suffolk, England (Natl Grid Ref TM 1009 6493). Total dissolved CO_3^{2-}/HCO_3^- coll as CO_2 absorbed in NaOH solution after acidification of groundwater in closed nitrogen purged system. Coll 1973 by T K Tate; subm by W M Edmunds.

SRR-203. Mendlesham Bottom 1 **15,290 ± 220**
$\delta^{14}C = -850.9 \pm 4.1‰$
$\delta^{13}C = -8.5‰$

Discharge from bottom pump at ca 68.9m depth in aquifer.

SRR-204. Mendlesham Bottom 2 **15,370 ± 120**
$\delta^{14}C = -852.4 \pm 2.2‰$
$\delta^{13}C = -8.5‰$

Duplicate sample of SRR-203.

SRR-205. Mendlesham Top 3 **7060 ± 120**
$\delta^{14}C = -584.7 \pm 6.1‰$
$\delta^{13}C = -13.4‰$

Discharge from top pump at ca 64.6m depth in aquifer.

SRR-206. Mendlesham Top 4 **7540 ± 80**
$\delta^{14}C = -608.7 \pm 3.7‰$
$\delta^{13}C = -13.2‰$

Duplicate sample of SRR-205.

Hadleigh Castle series, England

Wood and charcoal embedded in clay of landslipped slope on S side of Hadleigh Castle, England (51° 32′ N, 0° 36′ E, Natl Grid Ref TQ 810 858). Slope on London Clay falls from Castle to meet alluvium of adjacent Thames estuary. Coll 1973 and subm by P Gostelow, Imperial Coll, London.

SRR-222. Hadleigh Castle 1 **Modern**
$\delta^{14}C = -17.1 \pm 5.7‰$
$\delta^{13}C = -27.6‰$

Small wood fragments at ca 1.8 to 2.4m depth in distinct organic layer buried in upper region of slope.

SRR-223. Hadleigh Castle 2 **2080 ± 90**
$\delta^{13}C = -26.9‰$

Charcoal fragments in ca 1.5m thick organic layer parallel to ground surface in lower half of slope and overlain by ca 3m brown London Clay colluvium.

SRR-224. Hadleigh Castle 3 **2560 ± 50**
$\delta^{13}C = -25.2‰$

Wood fragments at ca 0.5m depth in silty clay alluvium at base of slope and infilling old drainage ditch cut into Thames valley alluvium.

SRR-319. Hadleigh Castle 4 **3730 ± 70**
$\delta^{13}C = -23.4‰$

Charcoal fragments at ca 1.5m depth in colluvium near base of slope.

SRR-320. Hadleigh Castle 5 **5840 ± 120**
$\delta^{13}C = -24.8‰$

Organic detritus and wood fragments at ca 5m depth in soft alluvial deposits of Hadleigh marshes.

General Comment (PG): although several conclusions may be drawn from these dates, they indicate that slope was abandoned for ca 2000 yr, giving general time scale for degradation of London Clay slopes.

Gransmoor Quarry series, England

Humified silty peat in exposed face at 7.6m OD alt, Gransmoor Quarry, Yorkshire, England (54° 1′ N, 0° 18′ W). Coll 1973 by S C Beckett; subm by J R Flenley, Univ Hull.

SRR-229. Gransmoor Quarry, 50 to 52cm depth **5100 ± 50**
$\delta^{13}C = -28.0‰$

SRR-230. Gransmoor Quarry, 94 to 96cm depth **8510 ± 60**
$\delta^{13}C = -27.7‰$

General Comment (JRF): ages mark boundaries of zone in pollen diagram where selective destruction of pollen is suspected.

West Runton 6 series, England

Wood (*Alnus glutinosa* Gaertn) from single tree trunk at 0.9m depth in interglacial deposits E of West Runton Gap, Norfolk, England (52° 56′ N, 1° 16′ E, Natl Grid Ref TG 190 431). Sec described in Page (1972). Coll May 1973 and subm by N R Page, Middlesex Polytech London. *Comment*: other samples from this stratum at this locality previously dated at 41,600 $^{+1600}_{-1300}$; T-1119, > 39,900; I-4755, and 25,900 ± 700; I-4719. In view of controversial interpretation of finite ages, isolation and analyses of several carbonaceous fractions of this new sample were made to investigate possible effect of *in situ* contamination in wood.

SRR-225. Untreated wood **>47,560**
$\delta^{14}C = -998.3 + 0.7‰$
$\delta^{13}C = -28.0‰$

Wood finely divided, washed in distilled water and dried in vacuum oven.

SRR-226. Humic free wood **>47,560**
$\delta^{14}C = -1000.4 + 0.7‰$
$\delta^{13}C = -25.0‰$

Finely divided wood digested in 5 successive aliquots of 1M KOH. Residue acidified and then washed till acid free. Dried in vacuum oven.

SRR-227. Humate extract **>47,500**
$\delta^{14}C = -1002.1 + 0.7‰$
$\delta^{13}C = -28.6‰$

Humics recovered by acidification (H_2SO_4) of alkali supernatant from SRR-226. Yield = 14.3% by weight of untreated wood.

SRR-228. Cellulose **>47,500**
$\delta^{14}C = -998.6 + 0.7‰$
$\delta^{13}C = -25.8‰$

Humic free wood digested in $NaClO_2$/HCl, cellulose washed acid free and dried in vacuum oven. Yield = 23.3% by weight of untreated wood.

General Comment (NRP): since no ^{14}C activity could be detected in any carbonaceous fraction from this fresh sample it must be emphasized that utmost care is required in laboratory processing of material of suspected interglacial origin if anomalous ages are to be avoided.

SRR-619. Eston Beacon **11,510 ± 70**
$\delta^{13}C = -28.2‰$

Peat from deposit ca 7.6cm thick and buried under ca 1.8m clay and silt in postglacial hollow 650m NWN of Eston Beacon, Tees Valley, Yorkshire, England (54° 34′ N, 1° 7′ W, Natl Grid Ref NZ 5659 1891). Coll 1973 and subm by D H Land, Inst Geol Sci, Leeds. *Comment* (DHL): this deposit directly overlies youngest glacial deposit in Tees Valley. Peat formed during Pollen Zone II (Allerod), and is same age as similar deposit at Neasham, 25km to WSW.

Blelham Tarn series, England

Postglacial organic lake mud in core (73/1) taken with 6m Mackereth corer in Blelham Tarn, England (54° 23′ N, 2° 58′ W, Natl Grid Ref NY 365 005). Quoted sample depth increments relate to present mud surface. Coll 1973 and subm by W Tutin (W Pennington), Univ Leicester. Palaeomagnetic analysis of this core by R Thompson, Univ Edinburgh.

SRR-254. Blelham Tarn, 50 to 60cm depth **930 ± 50**
$\delta^{13}C = -29.1‰$

SRR-255. Blelham Tarn, 90 to 100cm depth **910 ± 50**
$\delta^{13}C = -28.0‰$

SRR-256. Blelham Tarn, 120 to 130cm depth **1410 ± 50**
$\delta^{13}C = -28.0‰$

SRR-257. Blelham Tarn, 164 to 174cm depth **2070 ± 60**
$\delta^{13}C = -28.8‰$

SRR-258. Blelham Tarn, 181 to 191cm depth **2250 ± 50**
$\delta^{13}C = -28.8‰$

SRR-259. Blelham Tarn, 222 to 230cm depth **2910 ± 60**
$\delta^{13}C = -28.9‰$

SRR-260. Blelham Tarn, 273 to 280cm depth **3800 ± 50**
$\delta^{13}C = -28.3‰$

SRR-261. Blelham Tarn, 323 to 329cm depth **4860 ± 60**
$\delta^{13}C = -28.6‰$

SRR-262. Blelham Tarn, 335 to 342cm depth **5540 ± 60**
$\delta^{13}C = -28.7‰$

SRR-263. Blelham Tarn, 348 to 356cm depth **5440 ± 60**
$\delta^{13}C = -28.9‰$

SRR-264. Blelham Tarn, 359 to 366cm depth **5720 ± 60**
$\delta^{13}C = -28.6‰$

General Comment (WT/RT): percentage pollen diagram from parallel core has been pub (Pennington, 1965); in this dated core ca 30cm should be added to depth of each sample to correlate the 2. SRR-261-263 agree well with position of Elm Decline, and show deposition of older material on top of younger, comparable with findings at other Lake District sites. Otherwise smooth depth time scale from these dates shows acceleration of deposition at 2 horizons where pollen analysis indicated major episodes of anthropogenic forest clearance—a temporary 'Landnam' episode between 1 and 2 centuries BC, and more permanent deforestation at ca AD 1000, previously correlated (Pennington, 1965) with Scandinavian settlement recorded in local place names; this correlation is now shown to have been correct.

Palaeomagnetic measurements on the whole, unopened core correlate remarkably well, between 1000 and 1700 yr BP, with magnetic variations from Lake Windermere (Mackereth, 1971) and confirm Mackereth's palaeomagnetic results.

Ennerdale Water series, England

Detritus lake mud in core (71/1) from Ennerdale Water, Cumbria, England (54° 31′ N, 3° 22′ W, Natl Grid Ref NY 105 150). Core taken near deepest part of lake and quoted sample depth increments relate to present mud surface. Adjacent secs in core previously dated, SRR-183 and

-184 (R, 1974, v 16, p 247). Coll 1971 and subm by W Tutin (W Pennington).

SRR-307. Ennerdale Water, 367 to 377cm depth 4830 ± 60
$\delta^{13}C = -27.1‰$

SRR-308. Ennerdale Water, 377 to 387cm depth 5280 ± 60
$\delta^{13}C = -27.2‰$

SRR-309. Ennerdale Water, 387 to 397cm depth 5130 ± 60
$\delta^{13}C = -27.0‰$

General Comment (WT): samples are intermediate between SRR-183 and -184 in stratigraphic position. Plot of all 5 ages against depth below mud surface shows anomalous position of SRR-308; though its age overlaps with that of SRR-309 at 2σ confidence level, probability is that this sample represents disturbance of orderly accumulation of sediment by input of older organic matter from catchment soils. Pollen evidence confirms this interpretation. Sample SRR-309 falls at Elm Decline (Godwin zone boundary VII a/b) and agrees closely with dates for this horizon at other Lake District sites.

SRR-314. Trannack Farm 1810 ± 50
$\delta^{13}C = -26.5‰$

Wood at ca 2.5m depth in pebbly/sand sediment (Valley Gravel) 125m S of Trannack Farm, Penzance, England (50° 9′ N, 5° 25′ W, Natl Grid Ref SW 5647 3297). Coll 1973 and subm by A C Wilson, Inst Geol Sci. *Comment* (ACW): sample dates commencement of flood plain deposition and accords with comparable sequence at Praa Sands, 5km to SSE.

SRR-315. Trink Cottage 10,200 ± 50
$\delta^{13}C = -28.5‰$

Peat at ca 0.43m depth in sec through Valley Gravel deposit 310m N of Trink Cottage, Penzance, England (50° 11′ N, 5° 29′ W, Natl Grid Ref SW 5161 3737). Coll 1973 and subm by A C Wilson. *Comment* (ACW): dates youngest terrace gravel deposit.

SRR-633. Hambleton 10,860 ± 90
$\delta^{13}C = -26.4‰$

Organic mud from beneath shear surface at base of solifluction layer, Hambleton, Rutland, England (52° 40′ N, 0° 40′ W, Natl Grid Ref SK 8975 0815). Coll 1972 by R J Chandler, Dept Civil Eng, Imperial Coll, subm by Inst Geol Sci, London. *Comment* (RJC): provides upper limit to age of overlying solifluction layer, presumed to date from Zone III of Late Devensian. Compares with date, 11,819 ± 85; SRR-144 (R, 1974, v 16, p 245) of similar organic mud at comparable stratigraphic position and alt on opposite side of valley.

SRR-361. Nene Valley **7410 ± 120**
$\delta^{13}C = -4.5‰$

Snail shells at ca 0.5m depth in head deposit on landslip above R Nene, Northampton, England (52° 35′ N, 0° 24′ W, Natl Grid Ref TL 0816 9961). Coll 1972 and subm by A Horton, Inst Geol Sci. *Comment* (AH): defines younger limit of main landslip development which post dates 7469 BC (SRR-283).

SRR-283. Nene Valley **9420 ± 70**
$\delta^{13}C = -27.2‰$

Wood assoc with rich mollusk fauna at ca 2m depth in gravel at base of alluvial clay of R Nene, England (52° 35′ N, 0° 24′ W, Natl Grid Ref TL 0815 9960), alt 9m OD. Coll 1973 by R Chandler and subm by A Horton. *Comment* (AH): gravel is truncated by slip-plane and thus predates major landslip developed here.

Leeds Hippopotamus series, England

Large assemblage of skeletal remains (*Hippopotamus amphibius* Linne) excavated 1852 from clay pit at Wortley, Leeds, England (Natl Grid Ref SE 283 331). Bones, representing at least 2, probably 3 adults plus a juvenile, occurred well presented at 2.74 to 3.05m depth in dark blue clay and at 6.10m above 'present bed' of R Aire. Although generally considered of Ipswichian (interglacial) origin, relics may represent post-Roman dumping of imported animals. Curated by Leeds City Mus; subm by G D Gaunt, Inst Geol Sci, Leeds.

Several decontamination methods were employed in view of uncertain preservation treatments applied last century. For all samples, outer surface was physically removed and discarded to avoid obvious varnish layers.

SRR-360 (a). **31,600 $^{+1250}_{-1080}$**
$\delta^{13}C = -23.6‰$

Adult left femur. Finely ground bone digested in HCl/$KMnO_4$.

SRR-360 (b). **30,840 ± 520**
$\delta^{13}C = -23.6‰$

Adult left femur. Finely ground bone digested in HCl/acetone.

SRR-360 (c). **31,590 $^{+1250}_{-1080}$**
$\delta^{13}C = -23.4‰$

Adult left femur. Gelatin purified from collagen extract.

SRR-360 (d). **>40,070**
$\delta^{14}C = -993.5 \pm 1.7‰$
$\delta^{13}C = -21.9‰$

Adult molar tooth. Gelatin purified from collagen extract.

General Comment (DDH/JDG): as discussed in Harkness *et al* (1977) infinite age, SRR-360 (d), vindicates interglacial origin of these remains. Persistent finite ages obtained for bone (femur) sample are assumed to reflect 'modern' contamination introduced via preservation methods based on application of gelatin-based size.

Littlebrook series, England

Peat from 3 horizons in sequence of Flandrian alluvial deposits in 2 boreholes (Nos. 3 and 4) at site of Littlebrook Power Sta, Dartford, Kent, England (51° 27′ N, 0° 15′ E, Natl Grid Ref TQ 5614 7581). Coll 1973 and subm by B W Conway, Inst Geol Sci.

SRR-274. Littlebrook (BH/3), −1.7m OD **2650 ± 50**
$\delta^{13}C = -29.3‰$

SRR-275. Littlebrook (BH/3), −4.0m OD **4550 ± 60**
$\delta^{13}C = -28.8‰$

SRR-276. Littlebrook (BH/3), −5.2m OD **5460 ± 60**
$\delta^{13}C = -28.9‰$

SRR-277. Littlebrook (BH/3), −4.6m OD **5370 ± 60**
$\delta^{13}C = -29.1‰$

SRR-278. Littlebrook (BH/3), −8.0m OD **6820 ± 60**
$\delta^{13}C = -29.3‰$

SRR-279. Littlebrook (BH/4), −1.9m OD **2610 ± 50**
$\delta^{13}C = -29.1‰$

SRR-280. Littlebrook (BH/4), −3.9m OD **4220 ± 50**
$\delta^{13}C = -29.1‰$

General Comment (BWC): peat of 3rd level is 2.4m thick and age determinations (SRR-274-276, -280) indicate period > 1244 yr for its formation.

Bridgewick series, England

Marine shells from Borehole No. TRO9NW3 at Gengie Marshes, Bridgewick, Essex, England (51° 40′ N, 0° 55′ E, Natl Grid Ref TR 0142 9971) yielding late Flandrian chenier deposit in alluvial sequence. Coll 1973 and subm by B W Conway.

SRR-362. Bridgewick, 4.4m depth **14,540 ± 100**
$\delta^{13}C = -0.5‰$

SRR-363. Bridgewick, 5.5m depth **23,630 ± 150**
$\delta^{13}C = -0.7‰$

General Comment (BWC): an age not greater than 3000 BP was anticipated on stratigraphic evidence; no explanation is offered for ages determined.

SRR-282. Bradwell-on-Sea **>46,500**
$\delta^{14}C = -998.3 \pm 0.8‰$
$\delta^{13}C = -25.7‰$

Wood in borehole at 2m OD at Bradwell-on-Sea, Essex, England (52° 41′ N, 0° 46′ E, Natl Grid Ref TL 9872 0581). Brick earth overlies silts and silty clays occupying buried channel with base 3.4m OD. Coll 1973 and subm by B W Conway. *Comment* (BWC): infinite age confirms Pleistocene age of channel deposits.

Eastborough Farm series, England

Peaty clay from upper part of 2 peat levels in Flandrian alluvial sequence in Borehole (No. 14) at Eastborough Farm, Cooling, Kent, England (51° 28′ N, 0° 33′ E, Natl Grid Ref TQ 7755 7788). Coll 1973 and subm by B W Conway.

SRR-374. Eastborough Farm, 3.8m OD **4700 ± 50**
$\delta^{13}C = -27.3‰$

SRR-375. Eastborough Farm, 11.2m OD **6690 ± 80**
$\delta^{13}C = -28.2‰$

SRR-384. Bowers Marshes **5180 ± 70**
$\delta^{13}C = -27.8‰$

Peat from base of single peat horizon in sequence of Flandrian alluvial deposits at −2.8m OD in Borehole (No. TW 78 NWZ) Bowers Marshes, Pitsea, Essex, England (51° 33′ N, 0° 31′ E, Natl Grid Ref TQ 7472 8635). Coll 1973 and subm by B W Conway. *Comment* (BWC): peat of 3rd level is 0.8m thick and age determination indicates 96 yr for its formation.

SRR-370. Maplin Sands **>46,300**
$\delta^{14}C = -1002.1 + 0.8‰$
$\delta^{13}C = -30.0‰$

Peat at 22m depth in Borehole (No. W44) at Maplin Sands, East Essex, England (51° 35′ N, 1° 0′ E, Natl Grid Ref TR 6075 1918). Coll 1973 by B D'Olier, London Polytech; subm by Inst Geol Sci, London. *Comment* (BD): interpretation of this borehole indicated Holocene date, but date supports Devensian Interstadial or Ipswichian Interglacial age.

Langney Point series, England

Peat from site investigation borehole within coastal marsh deposits beneath shingle falls, Langney Point, Eastbourne, Sussex, England (50° 47′ N, 0° 19′ E, Natl Grid Ref TQ 4210 111). Surface level of borehole + 4.62m OD. Coll 1973 by Ove Arup and Partners; subm by B Young, Inst Geol Sci.

SRR-379. Langney Point, 29.5m depth **8760 ± 80**
$\delta^{13}C = -25.9‰$

SRR-380. Langney Point, 31.8m depth **9510 ± 90**
$\delta^{13}C = -29.6‰$

General Comment (BY): peat contains abundant fresh water mollusc fragments and hazel nuts and rests directly on Lower Greensand. Older date compares closely with those obtained from similar Holocene peats at base of buried channels of R Cuckmere, Airlington, Sussex (Wellin *et al,* 1971, p 28) and R Tillingham, Rye, Sussex (Wellin *et al,* 1974, p 100).

SRR-376. Paynes Farm **11,060 ± 110**
$\delta^{13}C = -27.9‰$

Peat from 1st floodplain terrace at ca 2.2m depth in gravel pit 37m W of Paynes Farm, Stanton Harcourt, England (51° 44′ N, 1° 24′ E, Natl Grid Ref SP 4212 0473). Coll 1973 by D Foster and subm by A W Kemp, Inst Geol Sci. *Comment* (AWK): dates 1st floodplain terrace.

West Dock series, Bristol

Peat from borehole at West Dock, England (51° 31′ N, 2° 43′ W, Natl Grid Ref ST 502 774). Coll by A B Hawkins, Univ Bristol; subm by Inst Geol Sci, London.

SRR-392. West Dock, Bristol, 3.58m depth **4490 ± 70**
$\delta^{13}C = -26.4‰$

SRR-393. West Dock, Bristol, 5.72m depth **5020 ± 70**
$\delta^{13}C = -28.7‰$

SRR-394. West Dock, Bristol, 6.17m depth **6050 ± 70**
$\delta^{13}C = -28.7‰$

General Comment (ABH): 2 peat bands occur within Flandrian sediments, which overlie sands and gravels with rare vertebrate remains. Older dates confirm that lower peat band is similar in age to reasonably widespread peat horizon in Somerset. It was hoped that detailed study of microfossils in deposits above upper peat band (date pre-Roman) would confirm no stratigraphic break as suggested by Godwin (1943) adding further evidence against Romano-British Transgression (Hawkins, 1971). Leaching of microfossils at higher horizons made this impractical (Murray & Hawkins, in press).

SRR-437. St Quen's Bay **3980 ± 50**
$\delta^{13}C = -29.3‰$

Peat from temporary storm beach exposure at St Quen's Bay, Jersey, Channel Is. (49° 13′ N, 2° 13′ W, Natl Grid Ref 7NW 5650 5170). Coll 1973 and subm by R G Thurrell, Inst Geol Sci.

Thorpe Bulmer series, England

Organic detritus in clay from core taken in lake bed Thorpe Bulmer, Hart, Co Durham, England (54° 43′ N, 1° 18′ W, Natl Grid Ref NZ 453 354). Band of clay, ca 75cm thick, between layers of organic deposit contains abundance of *Cannabis* pollen (ca 19% of total pollen) which indi-

cates cultivation of plant in this locality. Coll 1973 and subm by D D Bartley.

SRR-404. Thorpe Bulmer, 388 to 392cm depth **2060 ± 60**
$\delta^{13}C = -29.1‰$

Sample at ca 5cm above base of clay band, corresponds to onset of *Cannabis* cultivation.

SRR-405. Thorpe Bulmer, 343 to 347cm depth **850 ± 60**
$\delta^{13}C = -30.0‰$

Sample at ca 20cm below top of clay band, corresponds to end of *Cannabis* cultivation.

General Comment (DDB): samples support previous date for *Cannabis* max (GaK-3713; 1730 ± 120) and suggest that its cultivation began in this area in Iron age, reached a peak during Roman times and then continued at somewhat lower level until beginning of Norman period, when it ceased.

Mordon Carr series, England

Peat and detritus mud in core from deposit at Mordon Carr, Co Durham, England (54° 37′ N, 1° 30′ W, Natl Grid Ref NZ 321 253). Quoted sample depths relate to present bog surface at ca 69m alt. Coll 1974 and subm by C Chambers and D D Bartley.

SRR-474. Mordon Carr, 115 to 120cm depth **4540 ± 70**
$\delta^{13}C = -29.5‰$

Sphagnum subsecundum with increasing *Gramineae* pollen. Dates 1st major clearance phase.

SRR-597. Mordon Carr, 141 to 147cm depth **4740 ± 90**
$\delta^{13}C = -27.9‰$

Sphagnum subsecundum with 1st appearance of *Plantago* pollen.

SRR-475. Mordon Carr, 192.5 to 197.5cm depth **5310 ± 60**
$\delta^{13}C = -29.6‰$

Transitional muddy peat overlying elm decline horizon.

SRR-476. Mordon Carr, 200 to 205cm depth **5240 ± 70**
$\delta^{13}C = -29.9‰$

Detritus mud underlying elm decline horizon.

SRR-477. Mordon Carr, 297.5 to 302.5cm depth **7760 ± 70**
$\delta^{13}C = -31.0‰$

Detritus mud with increasing *Alnus* pollen.

SRR-478. Mordon Carr, 340 to 345cm depth **8690 ± 50**
$\delta^{13}C = -30.1‰$

Detritus mud with increasing *Betula* pollen.

Silver Lock series

Peat from Borehole at Silverlock Housing Development, Rotherhithe, London (51° 29′ N, 0° 3′ W, Natl Grid Ref TQ 3534 7860). Coll 1974 and subm by F G Berry, Inst Geol Sci.

SRR-435. Silverlock, 3m depth **2950 ± 50**
$\delta^{13}C = -29.4‰$

SRR-436. Silverlock, 1.5m depth **3180 ± 80**
$\delta^{13}C = -29.2‰$

General Comment (FGB): provides dates for evolution of subsidiary Thames drainage and deposition of gravels within soft alluvium. Lower and younger peat is assoc with channel cut in response to falling base level.

SRR-491. France Wood Marsh **1540 ± 40**
$\delta^{13}C = -29.2‰$

Coarse brown peat at 1.2m in Borehole (No. 50) France Wood Marsh, Start Bay, S Devon, England (50° 17′ N, 3° 39′ W, Natl Grid Ref SX 819 440). Sample from horizon 3.35m thick overlain by 0.85m surface deposits, present marsh surface at 3.21m OD. Coll 1974 by C Morey; subm by M W L Blackley. *Comment* (MWLB): sample is from infill of small valley formerly open to sea. Overlying deposits mark rapid increase in erosion rates within catchment—almost certainly result of human activity.

Slapton Ley series, England

Dark brown silty peat in Borehole (No. L53b) Slapton Ley, Start Bay, S Devon, England (50° 17′ N, 3° 39′ W, Natl Grid Ref SX 823 439). Borehole passes through lake, 1.7m water column with base at 2.71m OD. Coll 1974 by C Morey; subm by M W L Blackley.

SRR-492. Slapton Ley, −0.19m OD **1810 ± 40**
$\delta^{13}C = -29.6‰$

Sample at 0.8m depth in horizon overlain by successively 0.1m clay mud and 0.3m diatom rich gel mud.

SRR-493. Slapton Ley, −1.79m OD **2890 ± 50**
$\delta^{13}C = -28.3‰$

Sample at 0.2m above base of horizon described in SRR-492. This horizon overlies band of coarse detritus mud, 0.8m thick, which rests on estuarine clay.

General Comment (MWLB): samples represent top and base of infill of old coastal lagoon, now partly buried by modern beach gravels. Gravels impound a similar lagoon at higher level in which cycle of sedimentation is being repeated. Evidence suggests that beach movements were of sudden catastrophic type, separated by periods of relative stability. Dates give duration of 1 of these.

East Yorkshire series, England

Groundwater from Cretaceous Chalk, overlain by drift, of East Yorkshire, England. Total dissolved CO_3^{2-}/HCO_3^- coll as CO_2 absorbed in NaOH solution. Coll 1973 and subm by W M Edmunds.

SRR-342. Well 72/159 **10,440 ± 140**
$\delta^{14}C = -727.5 \pm 4.7‰$
$\delta^{13}C = -17.4‰$

Chalk borehole (Natl Grid Ref TA 094 368) 40m deep with suction at 30m.

SRR-343. Well 72/437 **3950 ± 80**
$\delta^{14}C = -388.5 \pm 5.8‰$
$\delta^{13}C = -15.4‰$

Chalk borehole (Natl Grid Ref TA 057 378) 30m deep.

Hutton Henry series, England

Peat in core taken from old lake deposit at Hutton Henry, Co Durham, England (54° 42′ N, 1° 21′ W, Natl Grid Ref NZ 418 353). Quoted depth intervals relate to present bog surface at 110m alt. Coll 1975 and subm by D D Bartley.

SRR-600. Hutton Henry, 150 to 160cm depth **1840 ± 70**
$\delta^{13}C = -27.4‰$

Peat with mosses and *Equisetum*. Dates pollen evidence for marked increase in agricultural activity, presumably Roman.

SRR-601. Hutton Henry, 380 to 390cm depth **3540 ± 80**
$\delta^{13}C = -26.6‰$

Fibrous peat with mosses and *Phragmites*. Dates pollen evidence for 1st major increase in agricultural activity.

SRR-713. Higher Try Farm, Penzance **4920 ± 60**
$\delta^{13}C = -27.6‰$

Peat in alluvial deposit at Higher Try Farm, Penzance, England (50° 10′ N, 5° 33′ W, Natl Grid Ref SW 4597 3606), alt 184m OD. Sample from lowest part of basin-peat horizon near source of Trevaylor stream. Peat crops out over small area of cultivated land immediately W of Farm, depth sequence—peat 0.75m, purplish gray clay with plant fragments 0.30 to 0.70m, sub-angular granite cobbles with clay matrix 0.1m. Coll 1974 and subm by A J J Goode, Inst Geol Sci, Exeter. *Comment* (AJJG): peat accumulated during Flandrian in basin related to earlier sea level.

Upper Thames series, England

Wood and plant debris in gravels of lower floodplain terrace at ca 3m above alluvium of conflux of R Thames and Windrush, England (51° 43′ N, 1° 24′ W, Natl Grid Ref SP 420 039). Coll 1973 and subm by D J Briggs, Univ Sheffield on behalf of Inst Geol Sci, London.

SRR-711. Upper Thames Floodplain **11,060 ± 70**
$\delta^{13}C = -27.9‰$

Peat lens at 1.6 to 1.9m depth in gravel terrace.

SRR-712. Upper Thames Floodplain **10,930 ± 70**
$\delta^{13}C = -27.7‰$

Peat lens at 2.2m depth in gravel terrace.

General Comment (DJB): dates confirm Zone II (Allerod) age of terrace deposits in this area as suggested by previous radiocarbon assays (11,250 ± 100 BP; Birm-105), molluscan faunas and sedimentary evidence.

SRR-440. Porlock Bay **5120 ± 60**
$\delta^{13}C = -30.1‰$

Woody peat from submerged forest in Porlock Bay, Somerset, England (51° 13′ N, 3° 37′ W, Natl Grid Ref SS 870 480). Coll 1974 and subm by A Whittaker, Inst Geol Sci, Exeter. *Comment* (AW): wood from *in situ* peat bed coll at extreme low water. Part of submerged forest drowned by Flandrian transgression.

Harder's Road series, England

Peat and wood fragments from older Thames alluvium in borehole at Harder's Rd, London (51° 28′ N, 0° 4′ W, Natl Grid Ref 3465 7649). Coll 1975 and subm by F G Berry, Inst Geol Sci, London.

SRR-719. Harder's Rd, 5.2 to 5.5m depth **>46,350**
$\delta^{14}C = -998.50 + 0.78‰$
$\delta^{13}C = -28.3‰$

SRR-720. Harder's Rd, 6.05 to 6.15m depth **>46,800**
$\delta^{14}C = -999.76 + 0.71‰$
$\delta^{13}C = -29.0‰$

General Comment (FGB): provides limiting date for aggradation of Channel phase dissecting highest errosional bench (at ca. −2.5m OD) of series of benches which occur beneath Lower Flood Plain Terrace.

SRR-721. Whitehall **2130 ± 50**
$\delta^{13}C = -28.6‰$

Organic detritus from Flandrian alluvium at 2.5m depth in Borehole (No. 2B) Whitehall, England (51° 50′ N, 0° 8′ W, Natl Grid Ref 2992 7987). Coll 1975 and subm by F G Berry. *Comment* (FGB): confirms general contemporaneity of deposition of Ty-Bourne alluvium in range established for New Palace Yard, 280 BC to AD 410 (S Limbrey, pers commun).

SRR-714. Gulwal Forest **4280 ± 50**
$\delta^{13}C = -24.7‰$

Cellulose fraction isolated from wood from submerged forest exposure 900m S of St Gulwal's Church, Penzance, England (50° 7′ N, 5° 31′ W, Natl Grid Ref SW 4837 3092). Coll 1974 and subm by A J J Goode. *Comment* (AJJG): wood was obtained from upper surface of peat on fore-

shore overlying mean low water mark. Tree remains (probably birch) both fallen and rooted are found on peat, which rests on head. Age of Gulwal submerged forest agrees reasonably well with age of that at Westward Ho, Devon (R, 1972, v 14, p 331) and indicates time of submergence during Flandrian transgression.

SRR-834. South Borrow Pit **>42,600**

$\delta^{14}C = -998.0 + 1.2‰$

$\delta^{13}C = -22.0‰$

Protein extracted from mammoth (*Elephas primigenius*) tusk buried in 1st gravel terrace at South Borrow Pit, Empingham Reservoir, Rutland, England (52° 39′ N, 0° 37′ W, Natl Grid Ref SK 935 071). Coll 1975 by P Hosewill, subm by A Horton. *Comment* (AH): provides no positive evidence on age of 1st terrace gravel.

C. Equador

Cangahua series, Equador

SRR-438. Quito, Equador **6470 ± 60**

$\delta^{13}C = -26.7‰$

Wood fragment from sediments overlying volcanic ash (Cangahua) at R La Raya crossing on Chilligallo Rd, Quito, Equador (0° 14′ S, 78° 32′ W). Coll 1974 and subm by C R Bristow, Inst Geol Sci.

SRR-439. Sangolqui, Equador **>48,800**

$\delta^{14}C = -998.4 \pm 0.6‰$

$\delta^{13}C = -24.4‰$

Wood from base of tephra deposit (Cangahua) Sangolqui, Equador (0° 15′ S, 78° 27′ W). Coll 1974 and subm by C R Bristow.

General Comment (CRB): Cangahua ash fall some 120cm thick crops out throughout N half of Equadorian Andes. K/Ar dating of older obsidian fragments gives ages up to 55,200 BP (Bonifaz, 1972); thus, deposition must have started between 48,000 and 55,200 BP. Younger date supports other evidence that deposition terminated in late Pleistocene or early Holocene.

SRR-618. Punta Juramijo **>32,870**

$\delta^{14}C = -993.9 + 2.7‰$

$\delta^{13}C = +2.4‰$

Rhinocorque humboldti (Valencienne) from lowest emerged beach (10m alt) of Tablazo formation 8km E of Manta, Equador (0° 56′ S, 80° 39′ W). Coll 1974 and subm by R Bristow, Inst Geol Sci, London. *Comment* (RB): fauna from this emerged beach contains no extinct forms, although some species no longer inhabit this part of Pacific coast. Date obtained indicates that formation of Tablazo deposits took place wholly within Pleistocene.

SRR-718. Rio Monjas, Equador **6750 ± 60**
$\delta^{13}C = -25.9‰$

Peat in deposit, ca 3m thick, at base of volcanic/sedimentary sequence overlying thick (up to 40m) agglomerate at Rio Monjas, San Antonio, 20km NNE of Quito, Equador (0° 1′ S, 78° 27′ W). Coll 1975 and subm by R Bristow. *Comment* (RB): agglomerate, whose source volcano is unknown, rests upon Cangagua ash. Overlying stratified base-surge deposits are related to extinct volcano Pululagua, which lies 10km NW. Wood fragments found near top of this deposit some 6km to N yielded date, 2305 ± 65 yr (Stuckenrath, pers commun). Thus, Fululagua must have been active for min of 4000 yr.

D. Indonesia

SRR-231. Padang Swamp, 1805 to 1814cm depth **9810 ± 80**
$\delta^{13}C = -24.7‰$

Clayey peat at base of core (1B) taken in Padang Swamp, Kerinci Valley, Jambi Prov, Sumatra (2° 12′ S, 101° 32′ E) at 950m alt. Coll 1972 and subm by J R Flenley. *Comment* (JRF): dates base of organic deposits in this core and base of pollen profile.

SRR-232. Sikijang Swamp, 1085 to 1094cm depth **11,110 ± 300**
$\delta^{13}C = -25.2‰$

Peat in core (SKG1) taken in Sikijang Swamp, Kerinci Valley, Jambi Prov, Sumatra (2° 15′ S, 101° 30′ E) at 1050m alt. Coll 1972 and subm by J R Flenley. *Comment* (JRF): dates base of organic deposit in this core and base of pollen profile.

SRR-233. Bento Swamp, 2035 to 2065cm depth **8720 ± 90**
$\delta^{13}C = -26.4‰$

Organic detritus in diatomaceous sediment in Cores 6 and 6B taken in Bento Swamp, Kerinci Valley, Jambi Prov, Sumatra (1° 47′ S, 101° 20′ E) at 1300m alt. Coll 1972 and subm by J R Flenley. *Comment* (JRF): dates deepest organic material obtained but not base of deposit. Also provides min age for volcanic-tectonic origin of swamp and max age for some volcanic deposits (possibly lahars) higher in core.

SRR-234. Sacrificial Pool, 83.8 to 85cm depth **9190 ± 120**
$\delta^{13}C = -21.9‰$

Fine detrital mud with occasional bands of coarse sand at base of sedimentary strata resting on granitic Sacrificial Pool, Gunug Kinabalu, Sabah, East Malaysia (6° 5′ N, 116° 30′ E) at 4000m alt. Coll 1972 and subm by J R Flenley. *Comment* (JRF): dates base of organic deposits in core and provides min age for deglaciation of Mt Kinabalu.

SRR-235. Lake Sipinggan, 720 to 735cm depth **10,320 ± 90**
$\delta^{13}C = -23.8‰$

Coarse detrital mud at base of core taken at margin of crater lake at 1445m alt, Lake Sipinggan, Siborongborong, Sumatra (2° 10′ N, 98° 50′ S).

Coll 1972 and subm by J R Flenley. *Comment* (JRF): dates base of organic deposits overlying tephra and provides min age for this crater which postdates main Lake Toba eruption.

E. Ireland

Lough Neagh series, Northern Ireland

Lignite from extensive deposit underlying boulder clay and exposed in bank of narrow r SW of Lough Neagh, Northern Ireland (54° 25′ N, 6° 45′ W, Natl Grid Ref H 8098 5202). Coll 1974 and subm by W I Mitchell.

SRR-716. Lough Neagh **>46,600**
$\delta^{14}C = -997.8 + 0.77‰$
$\delta^{13}C = -28.1‰$

Lignite from base of deposit.

SRR-717. Lough Neagh **>46,450**
$\delta^{14}C = -997.6 + 0.77‰$
$\delta^{13}C = -30.1‰$

Lignite from top of deposit.

General Comment (WIM): palynology of lignites indicates Hoxnian (Gortian) age.

Srah series, Ireland

Soils in fresh exposure cut into marine eroded face of stable sand dune pasture, Srah, Co Mayo, Ireland (54° 9′ N, 9° 57′ W, Irish Grid Ref F 726 264). Coll 1971 and subm by R S Crofts, Univ Coll, London.

SRR-294. Srah **2570 ± 80**
$\delta^{13}C = -27.7‰$

Alkali insoluble organic detritus isolated from brown sandy soil in band, 11cm thick, overlain by ca 33cm blown sand and 28cm present soil layer.

SRR-295. Srah **1570 ± 60**
$\delta^{13}C = -27.2‰$

Basal peat in layer 220 to 225cm below top surface of dune.

SRR-296. Doolough **1580 ± 80**
$\delta^{13}C = -26.4‰$

Alkali insoluble organic detritus isolated from black/brown soil at 140 to 150cm depth in stabilized sand dune pasture Doolough, Co Mayo, Ireland (54° 9′ N, 9° 57′ W, Irish Grid Ref F 727 230). Soil layer is overlain by ca 140cm blown sand. Coll 1971 and subm by R S Crofts.

SRR-297. Doolough **2230 ± 60**
$\delta^{13}C = -26.7‰$

Charcoal in soil layer at base of deflation hollow in mobile sand dune system Doolough, Co Mayo, Ireland (54° 7′ N, 9° 57′ W, Irish Grid Ref F 734 223). Coll 1971 and subm by R S Crofts.

SRR-298. Emly Beg **1050 ± 60**

$\delta^{13}C = -26.0‰$

Charcoal in ca band, 6cm thick, brown soil at ca 290cm depth in sand dune Emly Beg, Co Mayo, Ireland (54° 13′ N, 10° 3′ W, Irish Grid Ref F 663 328). Coll 1971 and subm by R S Crofts.

SRR-299. Cross Point **2370 ± 50**

$\delta^{13}C = -24.4‰$

Charcoal in brown sandy soil at 200 to 210cm depth in cliff top sand dune Cross Point, Co Mayo, Ireland (54° 12′ N, 10° 51′ W, Irish Grid Ref F 643 308). Coll 1971 and subm by R S Crofts.

SRR-281. Rosganna House **6650 ± 50**

$\delta^{13}C = -28.1‰$

Wood embedded in estuarine clay in low cliff at Rosganna House, 2.76km ENE of Carrickfergus Castle, Co Antrim, Ireland (54° 45′ N, 5° 45′ W, Irish Grid Ref J 441 885). Sample from ca 0.5m below top of clay which represents lowest emerged beach of Belfast Lough. Coll 1973 and subm by R A Old, Inst Geol Sci. *Comment* (RAO): dates upper age for estuarine clay.

SRR-383. Killough **8380 ± 70**

$\delta^{13}C = -28.2‰$

Peat pocket in sand containing marine shells and overlying late glacial clays Killough Brick Co pit, 1.5km NW of Killough, Co Down, Ireland (54° 16′ N, 5° 39′ W, Irish Grid Ref J 529 379). Coll 1973 and subm by H W Wilson, Inst Geol Sci. *Comment* (HWW): late glacial clays are pre-Flandrian whilst overlying sand and peat date from Flandrian transgression and are comparable with similar deposits in North Antrim.

SRR-715. Lougall **7880 ± 50**

$\delta^{13}C = -26.8‰$

Peat in narrow diatomite horizon exposed on E side of forest track 1km E of Ministry Agric Centre, Lougall, Northern Ireland (54° 24′ N, 6° 35′ W, Natl Grid Ref H 920 519). Coll 1974 and subm by W I Mitchell, Inst Geol Sci, Belfast. *Comment* (WIM): peat and Chara marl below are of Flandrian age.

F. Libya

Phase I series, Libya

Groundwater from Post-Middle Miocene sands of Sirte Basin, Libya with exception of WW36-103A (SRR-198) which is from Oligocene. All water samples were pumped from oil company camp supply wells, oil-field injection wells or, in case of JE-P (SRR-189) and JD-P (SRR-191) production wells drilled during exploration program. Total dissolved CO_3^{2-}/HCO_3^- coll as CO_2 absorbed in NaOH solution after acidification of 120L aliquots of groundwater in closed nitrogen purged system. Coll 1973 and subm by W M Edmunds, Hydrogeol Dept, Inst Geol Sci, Wallingford.

SRR-189. Well JE-P **$^{+1470}_{24,350}$**
$^{-1250}$
$\delta^{14}C = -951.8 \pm 8.1‰$
$\delta^{13}C = -5.9‰$

Well sited (28° 47′ N, 25° 46′ E) samples from 44m below water table.

SRR-190. Well 102-D **$^{+1690}_{23,400}$**
$^{-1400}$
$\delta^{14}C = -945.7 \pm 10.3‰$
$\delta^{13}C = -6.2‰$

Well sited (28° 48′ N, 21° 27′ E). Sampled from 18m below water table.

SRR-191. Well JD-P **$^{+850}_{27,210}$**
$^{-770}$
$\delta^{14}C = -966.2 \pm 3.4‰$
$\delta^{13}C = -6.4‰$

Well sited (28° 52′ N, 21° 2′ E). Sampled from 44m below water table.

SRR-192. Well E1-105(1) **7870 ± 100**
$\delta^{14}C = -624.6 \pm 4.3‰$
$\delta^{13}C = -3.6‰$

Well sited (28° 21′ N, 21° 49′ E). Sampled from 73.5m below water table.

SRR-193. Well E1-105(2) **7830 ± 70**
$\delta^{14}C = -622.4 \pm 3.1‰$
$\delta^{13}C = -3.5‰$

Duplicate sample of SRR-192 to check reliability of field coll method.

SRR-194. Well S1-103(1) **$^{+1230}_{35,800}$**
$^{-1070}$
$\delta^{14}C = -988.4 \pm 1.7‰$
$\delta^{13}C = -7.2‰$

Well sited (28° 43′ N, 21° 0′ E). Sampled from 76m below water table.

SRR-195. Well S1-103(2) **22,160 ± 210**
$\delta^{14}C = -936.6 \pm 1.6‰$
$\delta^{13}C = -7.2‰$

As for SRR-194 but sample coll 1 week later.

SRR-196. Well WSW35-103A **33,300 +1270 −1100**
$\delta^{14}C = -984.2 \pm 2.3‰$
$\delta^{13}C = -7.1‰$

Well sited (29° 1′ N, 20° 45′ E). Sampled from 66.5m below water table.

SRR-197. Well B1-95 **>41,650**
$\delta^{14}C = -996.1 \pm 1.4‰$
$\delta^{13}C = -8.2‰$

Well sited (29° 14′ N, 20° 43′ E). Sampled from ca 44m below water table.

SRR-198. Well WW36-103A **35,940 +1540 −1290**
$\delta^{14}C = -988.6 \pm 2.0‰$
$\delta^{13}C = -11.3‰$

Well sited (29° 2′ N, 20° 45′ E). Total depth 898.6m sampled from ca 721.5m below ground level.

SRR-199. Well WW52-103D **33,220 +710 −610**
$\delta^{14}C = -984.0 \pm 1.3‰$
$\delta^{13}C = -6.0‰$

Well sited (28° 53′ N, 20° 58′ E). Sampled from 62m below water table.

SRR-200. Well 160-59E **28,640 +660 −610**
$\delta^{14}C = -971.7 \pm 2.2‰$
$\delta^{13}C = -7.0‰$

Well sited (28° 41′ N, 21° 23′ E). Sampled from 57m below water table.

Kufra 1973 series, Libya

Groundwater pumped from various depths in Nubian sandstone at Agric Proj, Kufra Oasis, S Libya (24° 13′ N, 23° 17′ E). Samples coll using ion exchange columns. Coll 1973 and subm by W M Edmunds.

SRR-211. Well C-96 **40,090 +1470 −1240**
$\delta^{14}C = -993.2 \pm 1.1‰$
$\delta^{13}C = -8.1‰$

Well completed and irrigation pumping (75 1/sec) commenced May 1972. Total drilled depth 353m, screened interval (sampled depth) 252 to 353m.

SRR-212. Well C-113 **>41,650**

$\delta^{14}C = -995.2 \pm 1.4‰$

$\delta^{13}C = -8.5‰$

Well, part of main pivot-irrigated form, commissioned May 1972. Total drilled depth 272m, screened interval 150 to 272m.

SRR-213. Well C-78 **31,460 +1670 −1380**

$\delta^{14}C = -980.1 \pm 3.7‰$

$\delta^{13}C = -10.5‰$

Well, part of main pivot-irrigated form, commissioned May 1972. Total drilled depth 242m, screened interval 120 to 242m.

SRR-214. Well C-120 **39,300 +1380 −1180**

$\delta^{14}C = -992.5 \pm 1.2‰$

$\delta^{13}C = -6.7‰$

Well, in main part of pivot-irrigated area, commissioned early 1973. Total drilled depth 262m, screened interval 120 to 262m.

SRR-215. Well HQ-1 **23,150 +750 −680**

$\delta^{14}C = -944.0 \pm 5.0‰$

$\delta^{13}C = -7.1‰$

Well for new headquarters site drilled to S of irrigated form, commissioned early 1973. Total drilled depth 190m, screened interval 172 to 190m.

SRR-216. Well C-44 **39,200 +1310 −1130**

$\delta^{14}C = -992.4 \pm 1.2‰$

$\delta^{13}C = -8.6‰$

Well on main irrigated form, commissioned late 1972. Total depth 232m, screened interval 111 to 232m.

Jalu/Tazerbo series, Libya

Groundwater form Phase 2 region of IGS Jalu/Tazerbo proj. Total dissolved CO_3^{2-}/HCO_3^- coll as CO_2 absorbed in NaOH solution after acidification of groundwater samples in closed nitrogen purged system. Coll 1973 and subm by W M Edmunds.

SRR-335. Well T(T2-65) **>40,360**

$\delta^{14}C = -998.4 \pm 1.5‰$

$\delta^{13}C = -11.7‰$

Well sited (27° 10′ N, 22° 15′ E).

SRR-336. Well T(U1-65) **>40,360**
$\delta^{14}C = -995.4 \pm 1.5‰$
$\delta^{13}C = -10.7‰$

Well sited (27° 39′ N, 22° 9′ E).

SRR-337. Well T(FF1-65) **39,850 +1610 −1340**
$\delta^{14}C = -993.0 \pm 1.3‰$
$\delta^{13}C = -6.8‰$

Well sited (27° 52′ N, 22° 17′ E).

SRR-338. Sarir WW 541 **>46,500**
$\delta^{14}C = -996.9 \pm 0.8‰$
$\delta^{13}C = -5.6‰$

Well sited (27° 35′ N, 22° 25′ E).

SRR-339. Gatmir **5010 ± 60**
$\delta^{14}C = -464.0 \pm 3.8‰$
$\delta^{13}C = -4.9‰$

Shallow well at Gatmir oasis (29° 9′ N, 21° 47′ E). Sampling depth ca 4m.

SRR-340. Omar Fadel Well **5380 ± 100**
$\delta^{14}C = -488.1 \pm 6.5‰$
$\delta^{13}C = -3.2‰$

Well at Jalu oasis (29° 1′ N, 21° 35′ E). Sampling depth ca 8m.

SRR-341. Abdalla Rejab Well **7550 ± 140**
$\delta^{14}C = -609.0 \pm 6.5‰$
$\delta^{13}C = -5.2‰$

Well at Jalu oasis (29° 1′ N, 21° 35′ E). Sampling depth ca 8m.

SRR-201. A1-105 **8680 ± 60**
$\delta^{13}C = -6.9‰$

Fragments of ostrich egg shell on desert surface at apparent early Neolithic camp site N of Aquitaine Oil Co Concession A1-105, Libya (28° 27′ N, 23° 3′ E). Assoc with finds of projectile points, scrapers, bola stones, and ostrich bones. Coll 1973 and subm by W M Edmunds. *Comment* (WME): dated conditions of sufficient vegetational cover to support settlement, this area is now completely arid.

SRR-202. S1-103 **4400 ± 50**
$\delta^{13}C = -7.0‰$

Fragments of isolated ostrich egg on desert surface near oil cap S1-103, Libya (28° 43′ N, 21° 0′ E). Coll 1973 and subm by W M Edmunds.

Jalu Soil Pedestals series, Libya

Debris from isolated soil pedestals ca 6m high resting on gravel (serir) desert 30km SE of Jalu, Surt Basin, Libya (28° 22′ N, 21° 51′ E). Coll 1972 by E P Wright; subm by W M Edmunds.

SRR-207. Jalu Soil Pedestal 1 **1010 ± 50**

$\delta^{13}C = -22.0‰$

Carbonized wood fragments (tamarisk) at ca 3m above ground level. Sample dated was leached free of alkali soluble carbon and then acidified to remove possible carbonate impurity.

SRR-208. Jalu Soil Pedestal 1 **820 ± 80**

$\delta^{13}C = -21.5‰$

Alkali soluble carbon recovered from SRR-207.

SRR-209. Jalu Soil Pedestal 3 **620 ± 50**

$\delta^{13}C = -24.2‰$

Carbonized wood fragments at ca 3m above present desert surface. Sample pretreated to remove alkali soluble carbon and carbonate.

SRR-210. Jalu Soil Pedestal 5 **430 ± 60**

$\delta^{13}C = -23.4‰$

Conglomerate of wood fragments and tamarisk needles cemented with carbonate at ca 3m above present desert surface. Sample pretreated to remove alkali soluble carbon and carbonate.

General Comment (WME): materials dated to establish period when vegetation declined because of climatic change in Cyrenaica during Holocene and to provide additional information for interpretation of groundwater ages measured for this region.

Kufra Soil Pedestals series, Libla

Wood samples from series of soil pedestals, up to 10m high, on fringe of oasis 4km SSW of Kufra El Jawf, S Libya (24° 13′ N, 23° 17′ E). Coll 1973 and subm by W M Edmunds.

SRR-217. Kufra Soil Pedestal 1 **2630 ± 50**

$\delta^{13}C = -21.0‰$

Fossil wood from topmost layer of pedestal at ca 1m above halite horizon.

SRR-218. Kufra Soil Pedestal 2 **3000 ± 50**

$\delta^{13}C = -22.1‰$

Fossil wood at base of eroded pedestal. At this site ground level is 8 to 10m above present water table on edge of oasis.

General Comment (WME): date of SRR-218 should correspond to recent past max height of water table.

Modern Vegetation series, Libya

Living vegetation coll at site of groundwater dating projects. Coll and subm by W M Edmunds.

SRR-328. Kufra **152.8 ± 0.8% modern**

$\delta^{13}C = -26.4‰$

Alfalfa from experimental farm Kufra oasis, Libya (24° 13′ N, 23° 17′ E). Coll June 1973.

SRR-329. Surt Basin **151.6 ± 1.3% modern**
$\delta^{13}C = -20.3‰$

Unid plant species growing in gravel desert (serir) in vicinity of wildcat oil well S1-103 Surt Basin, Libya (28° 45′ N, 21° 0′ E). Coll Feb 1973 after particularly wet winter; this region of desert is normally completely barren.

SRR-330. Jalu **150.4 ± 0.6% modern**
$\delta^{13}C = -27.3‰$

Leaves of palmetto from Gatmir, small permanent oasis in Jalu group, Libya (29° 9′ N, 21° 47′ E). Coll 1973.

General Comment (WME): samples analyzed to determine typical isotope ratios for desert environment and hence afford basis for possible adjustment and interpretation of conventional ages derived for groundwater.

SRR-331. Camel bone **610 ± 70**
$\delta^{13}C = -17.2‰$

Collagen isolated from camel bones in wadi loess deposit, Libya (28° 29′ N, 19° 53′ E). Coll 1973 and subm by W M Edmunds. *Comment* (WME): estimates wadi erosion and sediment accumulation rate.

SRR-332. J1-103 **25,560 ± 180**
$\delta^{13}C = -4.1‰$

Calcrete (caliche) at 30 to 35cm depth in deposit on ca 2m high escarpment adjacent to wadi 3km SW of wildcat oilwell J1-103, Libya (28° 42′ N, 21° 11′ E). General topography is deflated gravel desert (serir) overlying Post-Middle Miocene arenaceous deposits. Silcreted wood fragments occur on adjacent desert surface. Coll 1972 and subm by W M Edmunds.

SRR-333. EE1-65(a) **31,800 ± 370**
$\delta^{13}C = -2.6‰$

Calcrete on desert surface at site of water well EE1-65, Libya (27° 41′ N, 22° 7′ E). Coll 1973 and subm by W M Edmunds.

SRR-334. EE1-65(b) **>46,500**
$\delta^{14}C = -1002.1 \pm 0.8‰$
$\delta^{13}C = -2.6‰$

Calcrete on desert surface 10km S of site EE1-65 (SRR-333). Coll 1973 and subm by W M Edmunds.

G. Norway

Billefjorden series, Vestspitsbergen

Marine shells in sequence of glacial beach deposits exposed in sea cliffs S of Kapp Ekholm, Billefjorden, Vestspitsbergen (78° 32′ N, 16° 45′ E). Samples from 2 secs ca 200m apart, *viz,* 28m beach and 20m beach as described in Boulton and Rhodes (1974). Quoted sample alts relate to present mean sea level. Coll 1971 and subm by G S Boulton, Univ East Anglia.

SRR-109. 28m beach, + 22m alt **9710 ± 50**

Mya truncata. Age is mean of 3 determinations to investigate possible age variation with depth in shell structure.

(a) 'Outer' fraction (25% by weight) **9810 ± 110**
$\delta^{13}C = +1.0‰$

(b) 'Middle' fraction (20% by weight) **9610 ± 80**
$\delta^{13}C = +1.1‰$

(c) 'Inner' fraction (35% by weight) **9710 ± 90**
$\delta^{13}C = +1.0‰$

SRR-110. 28m beach, + 15m alt **9660 ± 70**
$\delta^{13}C = +0.4‰$

Mya truncata.

SRR-111. 28m beach, + 15m alt **11,030 ± 440**
$\delta^{13}C = -2.8‰$

Malcoma calcarea.

SRR-112. 28m beach, + 3m alt **>42,900**
$\delta^{14}C = -995.1 + 1.2‰$
$\delta^{13}C = -1.6‰$

Mya truncata.

SRR-113. 28m beach, + 2m alt **>45,400**
$\delta^{14}C = -996.5 + 0.9‰$
$\delta^{13}C = -1.9‰$

Mya calcarea.

SRR-114. 20m beach, + 18m alt **8870 ± 80**
$\delta^{13}C = -0.7‰$

Mya truncata.

SRR-115. 20m beach, + 11m alt **>36,000**
$\delta^{14}C = -988.8 + 2.8‰$
$\delta^{13}C = +1.4‰$

Mya truncata.

SRR-116. 20m beach, + 6m alt **>42,700**
$\delta^{14}C = -1002.4 + 1.2‰$
$\delta^{13}C = -0.1‰$

Mya truncata.

General Comment (GSB): 28m beach sec provides evidence for glacial episode between 11,000 and 9800 BP. 20m beach sec indicates major glacial episode prior to 36,000 BP.

SRR-265. Tunsbergdal **9150 ± 70**
$\delta^{13}C = -26.8‰$

Peat in basal 2cm bog, 1.3m deep, contained between moraine ridges at ca 900m alt Tunsbergdal, S Norway (61° 30′ N, 7° 20′ E). Coll 1971

and subm by D N Mottershead, Portsmouth Polytech. *Comment* (DNM): min age for formation of moraines.

SRR-395. Tunsbergdalvann **6220 ± 60**
$\delta^{13}C = -27.9‰$

Peat in basal 3cm of layer, 1.6m, overlying glacial till at ca 450m alt near boathouse Tunsbergsalvann, Tunsbergdal, S Norway (61° 30′ N, 7° 20′ W). Coll 1971 and subm by D N Mottershead. *Comment* (DNM): lag of at least 2000 yr probably occurred between deglaciation of site and onset of blanket peat development.

SRR-293. Ekmanfjord, Vestspitzbergen **1210 ± 50**
$\delta^{13}C = -23.4‰$

Cellulose isolated from wood of drift stranded tree trunk (ca 8m × 0.7m diam) partially buried on landward side of shingle barried at foreshire NW of Blomesletta, Ekmanfjord, Vestspitzbergen (78° 38′ N, 14° 47′ E). Coll 1972 and subm by R S Crofts.

Spitsbergen fjords series, Spitsbergen

Marine sediment in cores from bed of Spitsbergen fjord system. Core 1 (78° 58′ N, 11° 55′ E), Core 2 (79° 1′ N, 11° 29′ E), Core 4 (79° 13′ N, 11° 57′ E). Quoted sample depths relate to present mud surface. Coll 1974 and subm by G S Boulton.

SRR-745. Core 1, 0.8m depth **4510 ± 80**
$\delta^{13}C = -25.0‰$

SRR-746. Core 1, 1.6m depth **4800 ± 150**
$\delta^{13}C = -23.3‰$

SRR-747. Core 2, 0.335 to 0.347m depth **4100 ± 110**
$\delta^{13}C = -22.1‰$

SRR-748. Core 2, 0.7 to 0.8m depth **4980 ± 100**
$\delta^{13}C = -22.9‰$

SRR-749. Core 2, 1.09 to 1.18m depth **3990 ± 80**
$\delta^{13}C = -21.8‰$

SRR-750. Core 2, 1.48 to 1.57m depth **5210 ± 90**
$\delta^{13}C = -27.8‰$

SRR-751. Core 4, 1.7m depth **4990 ± 210**
$\delta^{13}C = -22.5‰$

General Comment (GSB): in general, sedimentation rate in Spitsbergen fjords is related to distance from glacier to site of deposition. Age pattern suggests dramatic reduction in sedimentation rates after ca 4000 BP, implying retreat of glaciers involved. SRR-749 appears outwith age sequence.

H. Scotland

Cam Loch series, Scotland

Organic detritus in sediment coll with 6m Mackereth corer from Cam Loch, Elphin, Sutherland, Scotland (58° 5′ N, 5° 0′ W, Natl Grid Ref NC 210 135). Two cores taken at very close proximity *viz,* 1) core Cam 7210 comprises postglacial gyttja, and 2) core Cam 727 comprises late glacial and early postglacial sediment. Quoted sample depth increments for each core relate to present mud surface. Coll 1972 and subm by W Tutin (W Pennington).

SRR-238.	**Cam 7210, 180 to 190cm depth**	**3100 ± 80** $\delta^{13}C = -26.3‰$
SRR-239.	**Cam 7210, 210 to 220cm depth**	**3100 ± 80** $\delta^{13}C = -26.7‰$
SRR-240.	**Cam 7210, 300 to 310cm depth**	**4110 ± 70** $\delta^{13}C = -27.8‰$
SRR-241.	**Cam 7210, 350 to 360cm depth**	**4590 ± 80** $\delta^{13}C = -27.8‰$
SRR-242.	**Cam 7210, 400 to 410cm depth**	**5460 ± 70** $\delta^{13}C = -27.5‰$
SRR-243.	**Cam 7210, 450 to 460cm depth**	**6790 ± 80** $\delta^{13}C = -28.1‰$
SRR-244.	**Cam 7210, 500 to 510cm depth**	**8360 ± 100** $\delta^{13}C = -27.4‰$
SRR-245.	**Cam 7210, 540 to 550cm depth**	**9540 ± 90** $\delta^{13}C = -27.0‰$
SRR-246.	**Cam 727, 513 to 523cm depth**	**9220 ± 70** $\delta^{13}C = -21.2‰$
SRR-247.	**Cam 727, 526 to 536cm depth**	**10,230 ± 190** $\delta^{13}C = -19.0‰$
SRR-248.	**Cam 727, 536 to 545cm depth**	**10,600 ± 450** $\delta^{13}C = -24.2‰$
SRR-249.	**Cam 727, 545 to 555cm depth**	**10,700 ± 490** $\delta^{13}C = -24.8‰$
SRR-250.	**Cam 727, 555 to 565cm depth**	**12,440 ± 220** $\delta^{13}C = -25.4‰$
SRR-251.	**Cam 727, 565 to 575cm depth**	**12,760 ± 190** $\delta^{13}C = -26.4‰$
SRR-252.	**Cam 727, 575 to 584cm depth**	**11,920 ± 230** $\delta^{13}C = -23.9‰$

SRR-253. Cam 727, 584 to 594cm depth **12,940 ± 240**
$\delta^{13}C = -26.1‰$

General Comment (WT): lateral variation in total thickness of postglacial sediment made overlap in age/depth relationship evidenced by individual cores unavoidable.

1) *Postglacial series (core Cam 7210).* Lowest sample, SRR-245, falls, as expected from lithology and pollen stratigraphy, between SRR-246 and -247. Smooth curve of depth time scale provided by this series indicates general acceleration of sedimentation rate through postglacial time, comparable to that found at Loch a'Chroisg, within similarly peat-covered catchment (Pennington, 1973). On time scale provided here, comparable pollen zone boundaries appear to be synchronous with those at Loch Sionascaig and Loch Clair (Pennington *et al,* 1972). Temporary increase in sediment accumulation rate shown by SRR-238 and -239 coincides with pollen evidence for anthropogenic effects on vegetation in catchment, and can therefore be explained as result of accelerated soil erosion.

2) *Late glacial and early postglacial series (core Cam 727).* Series made to prepare absolute late glacial pollen diagram from region of such low percentage frequency of *Betula* that no development of late glacial woodland can be supposed. Constitutes most N series of Late Devensian ages as yet obtained in Britain. SRR-247, from lowest postglacial organic mud, agrees with accepted dates for lower boundary of Flandrian. SRR-248 and -249 cover deposits id by their pollen content as of Younger Dryas age and agree with accepted dates for this period. Close agreement of these 3 dates with conventional dates indicate that little error from hard water effect can have been present. SRR-252, from base of zone within higher deposition rates for *Betula* pollen (from regional pollen rain) id deposits of Allerod period, agrees with accepted dates for beginning of this period. SRR-253, from base of organic sediment, coincides with *Juniperus-Empetrum-Rumex* pollen assemblage zone, and agrees with date for *Juniperus-Rumex* zone at Blelham Bog, Lancashire (I-3590): both are interpreted as evidence for pre-Allerod climatic amelioration. SRR-250 and -251, which appear to indicate redeposition of older organic matter over younger, come from sediment within which high frequencies of *Empetrum* and sedge pollen, both poorly dispersed in air, would agree with interpretation of this material as product of intensified erosion of organic soils from catchment; but possibility of hard water error in these 2 dates cannot be entirely ruled out.

SRR-305. Loch Builg **11,770 ± 90**
$\delta^{13}C = -21.7‰$

Fine detritus mud at 11.0 to 11.1m depth in Kettle Hole, Loch Builg, Cairngorm Mts, Scotland (57° 5′ N, 3° 35′ W). Sample from base of deposit, ca 15cm thick, overlain by gray clay of Zone III age. Coll 1973 and subm by D E Sudgen, Univ Aberdeen. *Comment* (DES): site deglaciated before Zone II.

SRR-306. Cooper Hill **Modern**

$\delta^{14}C = -26.4 \pm 5.4‰$

$\delta^{13}C = -28.4‰$

Peat in buried soil horizon ca 1m depth, overlying fluvioglacial gravels, Cooper Hill, Forres, Scotland (57° 40′ N, 3° 35′ W, Natl Grid Ref 994 532). Coll 1973 and subm by D E Sugden.

Loch Etteridge series, Scotland

Organic detritus in late glacial clay/gyttja deposits from kettle hole containing Loch Etteridge, Inverness, Scotland (57° 1′ N, 4° 9′ W, Natl Grid Ref NN 688 929). Deposits from close to present loch shore overlain by ca 7m postglacial deposits. Coll 1973 and subm by J B Sissons, M J C Walker, and J J Lowe, Univ Edinburgh.

SRR-301. Loch Etteridge **9410 ± 210**

$\delta^{13}C = -24.4‰$

Clay gyttja from basal 4cm of postglacial deposits.

SRR-302. Loch Etteridge **10,760 ± 120**

$\delta^{13}C = -26.1‰$

Gyttja from upper 1.5cm of Late glacial Interstadial (conventional Zone II deposits).

SRR-303. Loch Etteridge **11,290 ± 170**

$\delta^{13}C = -28.8‰$

Gyttja from basal 1.5cm of organic-rich layer in interstadial deposits.

SRR-304. Loch Etteridge **13,150 ± 390**

$\delta^{13}C = -30.2‰$

Clay gyttja from basal 3 to 4cm of earliest organic deposits at this site.

General Comment (JBS): ages confirm inference from pollen analysis and stratigraphy that this is late glacial site. SRR-301, immediately above clay stratum, implies protracted minerogenic deposition at this relatively high (300m alt) site. SRR-302 accords well with accepted date for end of Late glacial Interstadial. SRR-304 implies early ice sheet decay in heart of Grampian Highlands.

Dundonald Burn series, Scotland

Peat, 0.3m thick, in excavation in Dundonald Burn, Irvine, Ayrshire (55° 36′ N, 4° 38′ W, Natl Grid Ref NS 3372 3717). Peat horizon overlain at ca 4.5m OD by 1.5m of sand and gravel of postglacial emerged beach and rests on blue clay, possibly till. Coll 1973 and subm by S K Monroe, Inst Geol Sci.

SRR-381. Dundonald Burn **8070 ± 70**

$\delta^{13}C = -29.9‰$

Sample from top 2cm of peat layer.

SRR-382. Dundonald Burn **9780 ± 90**
$\delta^{13}C = -28.9‰$

Sample from basal 2cm peat layer.

General Comment (SKM): younger date is comparable with that of peat at Dundonald Rd, Troon, and may immediately precede Flandrian transgression. Older date suggests sea regression before peat formed.

Moray Firth series, Scotland

Borehole No. 73/35. Wood fragments from micaceous silt sediment drilled from sea bed Moray Firth, Scotland (57° 46′ N, 2° 19′ W). Sea floor at 156m depth. Coll and subm by D E Lawson, Inst Geol Sci, Edinburgh.

SRR-322. 14.78 to 14.84m below sea bed **15,860 ± 770**
$\delta^{13}C = -26.4‰$

SRR-323. 14.84 to 14.87m below sea bed **16,290 ± 600**
$\delta^{13}C = -26.2‰$

SRR-324. 14.87 to 14.91m below sea bed **14,020 ± 500**
$\delta^{13}C = -26.4‰$

SRR-325. 14.91 to 14.95m below sea bed **16,630 ± 650**
$\delta^{13}C = -26.6‰$

General Comment (DEL): dates indicate late Devensian age for Quaternary laminated silt and clay facies of Moray Firth.

Borehole No. 74/17. Marine shells drilled from sea bed, N Sec, Moray Firth, Scotland (58° 13′ N, 3° 13′ W). Shells within glacial marine till-like deposit which occurs below 4m-thick band of pink clay, of 'Errol Beds'. Coll 1974 and subm by D E Lawson.

SRR-487. 22.5m below sea bed **>43,450**
$\delta^{14}C = -998.6 \pm 1.2‰$
$\delta^{13}C = +1.7‰$

Shell (*Arctica islandica*) at 8.5m below pink clay.

SRR-488. 23m below sea bed **>43,450**
$\delta^{14}C = -995.5 \pm 1.2‰$
$\delta^{13}C = +1.6‰$

Shell (*Arctica islandica*) at 9m below pink clay.

SRR-626. 44.5m below sea bed **>36,170**
$\delta^{14}C = -1000.0 \pm 2.8‰$
$\delta^{13}C = +1.4‰$

Shell at 30.5m below pink clay; near base of drift succession.

General Comment (DEL): infinite dates indicate that these Quaternary till-like sediments in Moray Firth are older than Middle Devensian.

Borehole No. 74/18. Shells from base of sequence of sands forming sea bed of N Sec, Moray Firth, Scotland (58° 10′ N, 2° 57′ W). Coll 1974 and subm by D E Lawson.

SRR-627. 12m below sea bed **12,400 ± 100**
$\delta^{13}C = +1.5‰$

General Comment (DEL): sands are late Devensian.

Borehole (Total) 12-21-1. Shells from upper part of thick drift sequence on sea bed, N Sec, Moray Firth, Scotland (58° 16′ N, 2° 53′ W). Coll 1974 and subm by D E Lawson.

SRR-628. 146 to 192m below sea bed **7650 ± 210**
$\delta^{13}C = +1.4‰$

General Comment (DEL): date proves that upper part of drift sequence is Flandrian.

South Forties series, North Sea

Shells dredged from sea bed of South Forties area, United Kingdom (57° 15′ N, 0° 26′ E). Coll 1974 and subm by N G T Fannin, Inst Geol Sci, Edinburgh.

SRR-620.
(a) outer fraction **6560 ± 90**
$\delta^{13}C = +2.3‰$

(b) inner fraction **6700 ± 80**
$\delta^{13}C = +2.5‰$

SRR-621.
(a) outer fraction **6950 ± 70**
$\delta^{13}C = +2.4‰$

(b) inner fraction **6890 ± 80**
$\delta^{13}C = +2.2‰$

SRR-353. Greenhill **9590 ± 70**
$\delta^{13}C = -28.2‰$

Basal 3cm of peat layer exposed at ca 0.6m depth in drainage ditch 700m NE of Greenhill, Crief, Scotland (56° 24′ N, 3° 35′ W, Natl Grid Ref NO 0182 2376). Coll 1972 and subm by I B Paterson, Inst Geol Sci, Edinburgh. *Comment* (IBP): dates beginning of growth of peat beneath Carse Clay deposits of Flandrian transgression in Forth and Tay valleys.

Modern Shell series

Whole marine shells coll alive at known dates from various locations around Scottish coast. Dated to investigate and determine basis for interpretation of conventional ages for fossil shells from U K sites. Curated by Royal Scottish Mus and subm 1973 by J D Peacock, Inst Geol Sci.

Outer 20% by weight of sample carbonate discarded via acid hydrolysis. Remaining material analyzed as separate 'inner' and 'outer' fractions (50% subdivision by weight).

SRR-354. Modern Shell
(a) 'outer' fraction $\delta^{14}C = -5.3 \pm 3.5‰$
$\delta^{13}C = 0.0‰$

(b) 'inner' fraction $\delta^{14}C = \mathbf{-9.6 \pm 3.5}‰$
$\delta^{13}C = +0.7‰$

Patella vulgaris from Fair Isle intertidal zone (59° 33′ N, 1° 38′ W, Natl Grid Ref HZ 210 720). Coll 1908.

SRR-355. Modern shell

(a) 'outer' fraction $\delta^{14}C = \mathbf{+9.5 \pm 3.7}‰$
$\delta^{13}C = +0.9‰$

(b) 'inner' fraction $\delta^{14}C = \mathbf{+1.9 \pm 4.7}‰$
$\delta^{13}C = +0.8‰$

Buccinum undatum from Seton Sands, Firth of Forth (55° 58′ N, 2° 55′ W, Natl Grid Ref NT 420 760). Coll 1929.

SRR-356. Modern shell

(a) 'outer' fraction $\delta^{14}C = \mathbf{-9.2 \pm 4.3}‰$
$\delta^{13}C = +1.3‰$

(b) 'inner' fraction $\delta^{14}C = \mathbf{-10.7 \pm 3.6}‰$
$\delta^{13}C = +1.4‰$

Cerastoderma edule from Hunterston Sands (55° 44′ N, 4° 53′ W, Natl Grid Ref NS 190 525). Coll 1926.

SRR-357. Modern shell

(a) 'outer' fraction $\delta^{14}C = \mathbf{+3.4 \pm 3.5}‰$
$\delta^{13}C = +0.5‰$

(b) 'inner' fraction $\delta^{14}C = \mathbf{-7.5 \pm 3.9}‰$
$\delta^{13}C = +0.3‰$

Dosina exoleta from Loch Broom between 0 and −7.0m OD (57° 51′ N, 5° 20′ W). Coll 1900.

SRR-710. Modern shell

(a) 'outer' fraction $\delta^{14}C = \mathbf{+ 19.9 \pm 5.0}‰$
$\delta^{13}C = +3.5‰$

(b) 'inner' fraction $\delta^{14}C = \mathbf{+22.9 \pm 6.4}‰$
$\delta^{13}C = +4.1‰$

(c) periostracum $\delta^{14}C = \mathbf{-31.7 \pm 9.3}‰$
$\delta^{13}C = -16.5‰$

Pinna fragilis from Skelmorlie Bank, Firth of Clyde, Scotland (55° 52′ N, 0° 56′ W, Natl Grid Ref NS 170 670). Coll ca 1920.

General Comment: data confirm apparent age phenomenon inherent in marine shell ages based on Lamont VII, 1961 formula. Whether $\delta^{13}C$ values are measured or estimated, reporting labs should make clear their approach in age calculation, otherwise uncertainties of several hundreds of yr are involved for N Atlantic coastlines (Mangerud, 1972).

Lochgilphead series, Scotland

Shells from pit dug in clay of foreshore 28m S of East Pier, Lochgilphead, Argyll, Scotland (56° 02′ N, 5° 26′ W, Natl Grid Ref 863 875). Coll 1973 and subm by J D Peacock.

Outermost 20% by weight of all samples discarded via scrubbing and acid digestion. Where size permitted, remainder of each sample was assayed as equally sized 'outer' and 'inner' fractions.

SRR-364. Lochgilphead, 0.6m depth

(a) 'outer' **11,690 ± 130**
$\delta^{13}C = -0.0‰$

(b) 'inner' **11,390 ± 110**
$\delta^{13}C = +0.3‰$

Modiolus modiolus.

SRR-365. Lochgilphead, 0.55 to 0.60m depth

(a) 'outer' **12,110 ± 130**
$\delta^{13}C = +0.5‰$

(b) 'inner' **11,730 ± 140**
$\delta^{13}C = +0.5‰$

Mya truncata.

SRR-366. Lochgilphead, 0.6m depth

(a) 'outer' **11,390 ± 120**
$\delta^{13}C = +1.0‰$

(b) 'inner' **11,690 ± 130**
$\delta^{13}C = +0.6‰$

Arctica islandica.

SRR-367. Lochgilphead, 0.75m depth **12,490 ± 190**
$\delta^{13}C = -0.7‰$

Macoma calcarea.

SRR-368. Lochgilphead, 1.05m depth

(a) 'outer' **13,620 ± 90**
$\delta^{13}C = +1.1‰$

(b) 'inner' **13,190 ± 85**
$\delta^{13}C = +1.0‰$

Arctica islandica.

SRR-369. Lochgilphead, 1.7m depth

(a) 'outer' **13,140 ± 90**
$\delta^{13}C = +0.1‰$

(b) 'inner' **12,650 ± 110**
$\delta^{13}C = +1.8‰$

Modiolus modiolus.

General Comment (JDP): SRR-364 and -366 refer to same horizon. Sample of *Mya truncata* (SRR-365), in growth position, was taken from slightly lower horizon, and its apparently higher level is caused by difficulties of measuring depth in this part of pit. Dates for 3 spp agree well, including that for *Modiolus modiolus,* which is sensitive to contamination. 0.6m level in pit is, therefore, dated with confidence at ca 11,100 BP, allowing for 400 ± 50 yr 'apparent age' correction. There is no reason to believe that SRR-367 is greatly in error, but discrepancy between 'outer' and 'inner' values of SRR-368 suggests that this is perhaps a little too old. Samples of *Modiolus modiolus* (SRR-369) coll immediately above permeable bed, may have had some shell structure replaced by younger carbonate. Results show that thin late glacial sequences in W Scotland may span considerable time range, and that deposition at this locality was probably intermittent.

SRR-371. Salt Ness **3940 ± 50**

$\delta^{13}C = -28.7‰$

Upper 2cm of peat deposit ca 0.3m thick and overlain by ca 0.07m beach gravel and sand below low water mark 200m W of Salt Ness, Shetland, Scotland (60° 14′ N, 1° 23′ W, Natl Grid Ref HU 3443 5035). Coll 1973 by D Flinn, Univ Liverpool; subm by Inst Geol Sci.

SRR-372. Ronas Hill **4640 ± 50**

$\delta^{13}C = -28.2‰$

Peat from base of deposit, ca 0.6m thick, in nivation hollow on Ronas Hill, Shetland, Scotland (60° 33′ N, 1° 26′ W, Natl Grid Ref HU 315 844). Coll 1973 by D Flinn, subm by Inst Geol Sci.

SRR-385. Castleton **4010 ± 50**

$\delta^{13}C = -30.0‰$

Wood from temporary excavation, Castleton, Forfar, Scotland (56° 37′ N, 3° 5′ W, Natl Grid Ref NO 3300 4690). Coll 1973 and subm by I B Paterson, Inst Geol Sci. *Comment* (IBP): dates blanket bog growth during Atlantic times.

SRR-386. Ardler **9730 ± 60**

$\delta^{13}C = -28.4‰$

Peat from horizon ca 0.45m thick resting on gravelly sand and overlain by ca 0.61m gray sand, Ardler, Scotland (56° 33′ N, 3° 11′ W, Natl Grid Ref NO 2743 4173). Coll 1973 and subm by I B Paterson. *Comment* (IBP): dates onset of episode of widespread peat formation, which in Forth and Tay valleys is represented by peat layer beneath Carse Clay deposits of Flandrian Transgression.

SRR-387. Brinziehill **12,390 ± 100**

$\delta^{13}C = -27.8‰$

Peat from horizon ca 0.45m thick overlain by ca 0.61m till-like material, Brinziehill, Scotland (56° 54′ N, 2° 20′ W, Natl Grid Ref NO 7936 7918). Coll 1974 and subm by I B Paterson. *Comment* (IBP): dates in-

crease in vegetation cover as result of improved climatic conditions during Allerod interstadial.

SRR-388. Darnoe **11,860 ± 90**
$\delta^{13}C = -28.7‰$

Peat 0.1 to 6m thick resting on glacial gravels and overlain by ca 0.9m medium sand in temporary excavation, Darnoe, Fife, Scotland (56° 19′ N, 3° 12′ W, Natl Grid Ref NO 2596 0920). Coll 1973 and subm by M A E Browne, Inst Geol Sci. *Comment* (MAEB): dates increase in vegetation cover as result of improved climatic conditions during Allerod interstadial.

SRR-389. Plains **4040 ± 50**
$\delta^{13}C = -30.0‰$

Twigs from medium sand beneath thin peat beneath ca 1.3m silty clay in temporary excavation, Plains, Fife, Scotland (56° 17′ N, 3° 12′ W, Natl Grid Ref NO 2527 1093). Coll 1973 and subm by M A E Browne. *Comment* (MAEB): dates blanket bog growth during Atlantic times.

SRR-390. East Brackley **11,100 ± 160**
$\delta^{13}C = -29.7‰$

Peat from lowest of 3 thin layers interbedded with coarse sand, East Brackley, Fife, Scotland (56° 10′ N, 3° 23′ W, Natl Grid Ref NT 1447 9871). Coll 1973 and subm by M A E Browne. *Comment* (MAEB): dates increase in vegetation cover as result improved climatic conditions during Allerod interstadial.

SRR-391. Shiells **13,640 ± 130**
$\delta^{13}C = -19.8‰$

Organic debris from silt, 0.12m thick, beneath 4.6m of fine sand containing thin peat layer 1.3m below its top, overlain by surface peat. Temporary excavation Shiells, Fife, Scotland (56° 17′ N, 3° 10′ W, Natl Grid Ref NO 2796 1018). Coll 1973 and subm by M A E Browne. *Comment* (MAEB): dates increase in vegetation cover as result of improved climatic conditions during Allerod interstadial.

SRR-396. Holm **8800 ± 70**
$\delta^{13}C = -27.9‰$

Basal 5cm of subtidal peat horizon at −3.1m OD resting on glacial till, Holm, Isle of Lewis, Scotland (58° 10′ N, 6° 30′ W, Natl Grid Ref NB 463 316). Coll 1974 and subm by J Von Weymarn, Univ Aberdeen. *Comment* (JVW): age is relatively old but not unexpected since basal peat at Holm marks onset of peat growth after deposition of glacial till.

SRR-373. Weisdale **7760 ± 90**
$\delta^{13}C = -27.8‰$

Ca 2.5cm thick peat overlain by soliflucted material beneath small kame by Burn of Weisdale, Shetland, Scotland (60° 16′ N, 1° 17′ W, Natl

Grid Ref HU 3985 5398). Coll 1973 by D Flinn and subm by Inst Geol Sci. *Comment* (DF): peat postdates kame formation.

SRR-479. Inverkip Power Station

(a) outer fraction **12,560 ± 60**
$\delta^{13}C = +1.2‰$

(b) inner fraction **12,620 ± 70**
$\delta^{13}C = +1.3‰$

Shells (*Arctica islandica*) preserved with epidermis from ca + 2m OD at ca + 0.3m above base of late glacial clays (Clyde Beds) overlying laminated deposits at Inverkip Power Sta excavation, Renfrewshire, Scotland (55° 54′ N, 4° 53′ W, Natl Grid Ref NS 197 713). Outer 20% by weight of sample discarded via scrubbing and acid hydrolysis. Remaining material dated as separate 'inner' and 'outer' fractions (50% subdivision by weight). Coll 1973 and subm by I B Paterson. *Comment* (IBP): oldest limiting date obtained so far for deglaciation of this part of Firth of Clyde.

SRR-480. Loch Cuithir **2500 ± 120**
$\delta^{13}C = -27.7‰$

Peat from base of deposit overlying diatomite deposit at 0.91m depth, Loch Cuithir, Isle of Skye, Scotland (57° 33′ N, 6° 14′ W, Natl Grid Ref NG 474 955). Coll 1974 by R H S Robertson and subm by J D Peacock, Inst Geol Sci, Edinburgh. *Comment* (RHSR): date gives youngest limit for formation of diatomite in which climatic optimum ca 7000 BP is suggested by numerous hazel nuts which occur at same depth in deposit.

Ardyne Point series, Scotland

Shells from temporarily exposed secs of late glacial clay ('Clyde Beds') at oil platform construction site at Ardyne Point, Argyll, Scotland (55° 52′ N, 5° 4′ W). At this locality, informally designated 'Clyde Beds' include shelly marine silts overlying laminated silt and clay, also marine. In 'Shell Pit' shelly beds lie with apparent conformity on underying laminated clay, but in 'Elf Pit' fossilferous beds rest with marked unconformity on laminated silt and till. Over 20% by weight of all samples discarded via scrubbing and acid hydrolysis, remaining material dated as separate 'inner' and 'outer' fractions (50% subdivision by weight). Coll 1974 and subm by J D Peacock.

SRR-481. Ardyne Point (Shell Pit, −1.0m OD)

(a) 'outer' fraction **12,150 ± 120**
$\delta^{13}C = +1.8‰$

(b) 'inner' fraction **11,680 ± 170**
$\delta^{13}C = +1.0‰$

Arctica islandica from 'Shell Pit' exposure 250m ESE of Ardyne Point (Natl Grid Ref NS 0983 6832). Shells at 1.65m above change in lithology from laminated brown silt and clay below to gray sulphide-rich silt above.

SRR-482. Ardyne Point (Shell Pit, −1.6 to −1.7m OD)

(a) 'outer' fraction **12,650 ± 70**
$\delta^{13}C = +0.3‰$

(b) 'inner' fraction **12,380 ± 90**
$\delta^{13}C = +0.9‰$

Modiolus modiolus from 'Shell Pit' exposure. Shells at level of lithologic change (See SRR-481).

SRR-483. Ardyne Point (Elf Pit, −5.5m OD)

(a) 'outer' fraction **11,470 ± 70**
$\delta^{13}C = +1.7‰$

(b) 'inner' fraction **11,530 ± 60**
$\delta^{13}C = +1.7‰$

Arctica islandica from 'Elf Pit' exposure 400m SE of Ardyne Point (Natl Grid Ref NS 0990 6813). Shells at base of fossiliferous beds.

SRR-615. Ardyne Point (Elf Pit, −3.5m OD) **10,750 ± 140**
$\delta^{13}C = +0.9‰$

Mya truncata from top of sec (see SRR-483) (Natl Grid Ref NS 0990 6813). Outer 20% of shells discarded, remaining material insufficient to allow 'inner' and 'outer' determinations. *Comment* (JDP): result suggests that 'inner' value for SRR-484 (10,840 ± 100) obtained from 0.5m lower in sec, is reliable, and confirms that deposit was laid down during Loch Lomond Readvance stage.

SRR-484. Ardyne Point (Elf Pit, −4.0m OD)

(a) 'outer' fraction **10,230 ± 210**
$\delta^{13}C = +1.1‰$

(b) 'inner' fraction **10,840 ± 100**
$\delta^{13}C = +0.7‰$

Mya truncata from 'Elf Pit' exposure. Shells 0.5m from top of fossiliferous beds (see SRR-483).

SRR-485. Ardyne Point (Elf Pit, −5.2m OD)

(a) 'outer' fraction **11,170 ± 70**
$\delta^{13}C = -0.4‰$

(b) 'inner' fraction **11,120 ± 110**
$\delta^{13}C = +1.0‰$

Mya truncata from 'Elf Pit' exposure 380m SE of Ardyne Point (Natl Grid Ref NS 0991 6817). Shells at base of marine clay overlying till.

SRR-486. Ardyne Point (Elf Pit)

(a) 'outer' fraction **10,560 ± 60**
$\delta^{13}C = +1.1‰$

(b) 'inner' fraction **10,620 ± 70**
$\delta^{13}C = +1.0‰$

Mya truncata from 'Elf Pit' exposure. Shells at top of marine clay sec (see SRR-485).

General Comment (JDP): sequences span classic Allerod interval and Loch Lomond Readvance (Younger Dryas) stade. Fossiliferous beds in 'Shell Pit' are evidently cut out below marked unconformity seen in 'Elf Pit'. Preliminary analysis suggests that conditions during 10,000 to 11,000 BP interval defined by dates were arctic, whereas those during 11,000 to 12,000 BP interval were less rigorous. Results imply, firstly, that 10,000 to 11,000 BP interval can be correlated directly with Younger Dryas stade and, secondly, that marine shell dates, when corrected for 'apparent age' phenomenon (ca 400 yr), are directly comparable in this sequence with those obtained on terrestrial plant material. Absence of corrected dates > 12,000 BP suggests possibilities of non-sequences or slow deposition at base of fossiliferous beds, or relatively late deglaciation of area.

SRR-489. Lochgilphead, 1.05m depth

(a) 'outer' fraction **12,510 ± 60**
$\delta^{13}C = +1.6‰$

(b) 'inner' fraction **12,590 ± 70**
$\delta^{13}C = +1.8‰$

Arctica islandica from pit in foreshore 28m S of East Pier, Lochgilphead, Argyll, Scotland (56° 2′ N, 5° 26′ W, Natl Grid Ref NR 863 875). Coll 1973 and subm by J D Peacock. *Comment* (JDP): date accords with other evidence at this locality and therefore preferred to SRR-368.

Whitehorn series, North Sea

Shell and lignite samples from Marr Bank Beds, a major seismic unit up to 60m thick in bed of North Sea. Formation rests on planed pre-Tertiary rock surface which ranges from 60 to 120m below sea level, and extends onto older drift deposits including Swatchway Beds and Aberdeen Ground Beds. Marr Bank Beds are marine sediments which occur approx to W of line 56° 00′ N, 0° 00′ W and 57° 50′ N, 1° 00′ W. Coll 1974 and subm by R Holmes, Inst Geol Sci, Edinburgh.

SRR-622. Borehole No. 74/6 **7110 ± 60**
$\delta^{13}C = +1.9‰$

Shells at ca 4m depth below surface of flat sea bed beneath 70m water column (54° 34′ N, 0° 49′ W).

SRR-623. Borehole No. 74/7 **13,170 ± 400**
$\delta^{13}C = -26.6‰$

Lignite at 25 to 28.5m depth below sea bed beneath 70m water column (59° 59′ N, 1° 8′ W).

SRR-624. Borehole No. 74/7 **21,710 ± 680**
$\delta^{13}C = -27.6‰$

Lignite at 23.5 to 25m depth below sea bed beneath 70m water column.

SRR-625. Borehole No. 74/7 **17,730 ± 480**
$\delta^{13}C = -25.3‰$

Lignite at 15.5 to 17.5m depth below sea bed beneath 70m water column.

General Comment (RH): lignite was finely disseminated in silty sands which were sieved to provide sufficient material for dating. Possible contamination from 1) coal dust derived from coal bearing strata which outcrop 50 to 60km west, and 2) microscopic modern wood debris derived from wooden drilling platform. Largest lignite fragments hand-picked to limit possible contamination. Nevertheless, youngest date given by sample at lowest stratigraphic level. Thus, all lignite-based results may possibly be suspect. In adjacent areas, Marr Bank Bed have been channeled by sediments that were correlated with Errol Clay (dated at 13,000 BP (Gregory *et al,* in press).

If valid, younger lignite dates (SRR-624 and -625) could be true. Shells of SRR-622 may indicate later period of sedimentation and may not form part of seismically defined Marr Bank Beds.

Josephine Field series, North Sea

Shell and lignite from Borehole (No. 30/13-IX) in Josephine Field, North Sea, Scotland (56° 34′ N, 2° 32′ E). Borehole depths recorded from sea level. Coll 1970 and subm by R Holmes.

SRR-629. 183 to 201m depth **>23,170**
$\delta^{14}C = -986.3 + 10.5‰$
$\delta^{13}C = -27.9‰$

Fossil wood (*Taxus*).

SRR-630. 381 to 389m depth **47,720 +1940 −1560**
$\delta^{13}C = -26.5‰$

Fossil wood.

SRR-631. 320 to 328m depth **32,680 +530 −500**
$\delta^{13}C = -27.4‰$

Fossil wood.

SRR-632. 259 to 267m depth **6970 ± 100**
$\delta^{13}C = +1.0‰$

Shells (bivalve and *Dentalium tests*).

General Comment (RH): samples from Aberdeen Ground Beds, uniform seismic unit extending from 20 to 200m depth below sea bed to within tens of m of top of Pliocene, and typifying much of deeper Quaternary between 56° and 58° in UK sec of North Sea. Upper limit of formation defined by erosion surface which may be overlain by various younger divisions, including Marr Beds and Upper Channel Deposits (see SRR-622-625). Aberdeen Ground Beds are thought to be entirely marine, though SRR-629 contained Yew and Juniper whilst Birch, Adler, Poplar, Willow, and Spruce were id from SRR-630-632. In Josephine Field, total Quaternary thickness probably exceeds 700m of which Aberdeen Ground Beds constitute more than half. Recovery of middle Devensian wood at -389m suggests late Quaternary deposition rates were more rapid than those of earlier Quaternary.

Mill of Dyce series, Scotland

Plant bed 32cm thick at 40 to 45m OD consisting of gray silty clay interbanded with layers of vegetation (twigs and plant debris) up to 2cm thick, forming lens dipping at 34° at contact of upper sand and middle gravel in glacio-fluvial and fluviatile sand/gravel/sand sequence exposed in Mill of Dyce (St Fergus) sandpit, Aberdeen, Scotland (57° 13′ N, 2° 13′ W, Natl Grid Ref NJ 8713 1496). Coll 1975 and subm by J D Peacock.

SRR-762. Mill of Dyce **11,550 ± 80**
$\delta^{13}C = -28.1‰$

Upper 5cm of plant bed.

SRR-763. Mill of Dyce **11,640 ± 70**
$\delta^{13}C = -27.6‰$

Basal 5cm of plant bed.

General Comment (JDP): plant bed occurs in valley or basin that coincides with broad syncline in sediments. Collapse feature (high dips and faulting) noted elsewhere in pit are thought to be caused by melting of buried glacial ice; this is preferred explanation for dip of plant bed. Alternative possibility that high dips are caused by water expulsion is less likely because plant bed is undisturbed, and no tight folds or injection phenomena were seen. Final melting of buried glacial ice may have been post-dated to 11,550 BP, *ie,* melting probably occurred > 1500 yr after disappearance of general cover of glacial ice in district (≥ 13,000 BP).

Portavadie series, Scotland

Marine shells in late/postglacial deposits (Clyde beds) 247km W of Portavadie, Argyll, Scotland (55° 54′ N, 5° 18′ W, Natl Grid Ref NR 927 695). Coll 1975 and subm by J D Peacock.

Outer 20% of samples discarded by scrubbing and acid leach. Remaining material equally subdivided in 'inner' and 'outer' carbonate fractions via controlled acid hydrolysis (2M HCl).

SRR-831. Portavadie, 2m OD

(a) 'outer' fraction **10,830 ± 150**
$\delta^{13}C = +0.9‰$

(b) 'inner' fraction **11,140 ± 220**
$\delta^{13}C = +1.8‰$

Mya truncata exposed in excavation near top of late glacial horizon.

SRR-832. Portavadie, 5.2m OD

(a) 'outer' fraction **11,750 ± 70**
$\delta^{13}C = +1.7‰$

(b) 'inner' fraction **11,930 ± 80**
$\delta^{13}C = +1.5‰$

Arctica islandica exposed in excavation at base of shelly 'Clyde Beds' deposit.

General Comment (JDP): apparent ages derived from normalized ages suggest that sequence spans last half of classic Allerod interval. There may be non-sequence at base of shelly beds, which here rest on sparsely fossiliferous red laminated clay.

SRR-833. Cardross

(a) 'outer' fraction **12,720 ± 170**
$\delta^{13}C = -0.4‰$

(b) 'inner' fraction **12,720 ± 240**
$\delta^{13}C = -0.5‰$

Shells (*Arctica islandica*) in shelly clay overlying laminated silts and sands at 7.5m OD Cardross, Dumbarton, Scotland (55° 58′ N, 4° 40′ W, Natl Grid Ref NS 3410 7778). Coll 1975 by J Rose; subm by J D Peacock. Subdivision of samples as for SRR-831. *Comment* (JDP): compares with N475; 11,900 ± 205 BP and GU-12; 11,787 ± 122 BP, also obtained from base of marine clay overlying laminated deposits. Suggest possibility of slow deposition or non-sequence near base of shelly clay.

I. Wales

Borth series, Wales

Cellulose isolated from wood fragments (*Pinus*) buried under ca 0.9m alluvium and ca 0.3m silty peat exposed in drainage ditch at Borth, Cardiganshire, Wales (52° 29′ N, 4° 3′ W, Natl Grid Ref SN 6149 8889). Coll 1973 and subm by R Cave, Inst Geol Sci.

SRR-377. Borth **1100 ± 50**
$\delta^{13}C = -27.0‰$

SRR-378. Borth **1220 ± 50**
$\delta^{13}C = -26.5‰$

General Comment (RC): sediments probably channel fill estuarine silt of R Leri rather than part of Borth Bog sequence.

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