

## CAMBRIDGE UNIVERSITY NATURAL RADIOCARBON MEASUREMENTS I

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The dates given have been obtained up to the end of December, 1958. They have been made with carbon dioxide at 2 atmospheres pressure in a proportional counter of about 2-liter volume. For further details of construction and procedure, see Godwin, Walker, and Willis, 1957. The establishment of the project was made possible by a grant from the Trustees of the Nuffield Foundation, whom we are most happy to thank along with the Imperial Smelting Corporation who have lent us the zinc shielding for the gas-counter.

Where not otherwise stated, the collectors of the samples were members of the staff or students working in the Cambridge University Sub-department of Quaternary Research, Botany School, Cambridge. The samples were all taken in conjunction with pollen-analytic, stratigraphic, or other Quaternary investigations. These collectors include H. Godwin, E. H. Willis, D. Walker, R. G. West, A. G. Smith, J. J. Donner, and R. P. Suggate.

### SAMPLE DESCRIPTIONS

#### BRITISH ISLES

##### *A. Pollen-Zone-Boundary Determinations (Scaleby Moss)*

The whole vertical sequence through a raised bog (Hochmoor) (54° 51' N Lat, 2° 52' W Long, Nat. Grid Ref. 431635) has been carefully pollen-analyzed. In a peat monolith transferred to the laboratory each major pollen-zone boundary was identified by further pollen analysis, and then two or three contiguous peat samples were taken as thin slices through the monolith at each horizon. These samples were combusted without preliminary leaching: they extend from zone II of the Late-glacial period to zone VIIb of the postglacial. The results are considered in detail in Godwin, Walker, and Willis, 1957: pollen analyses are by D. Walker, collection by D. Walker, H. Godwin, and others, radiocarbon assay by E. H. Willis. The pollen zones are those currently in use in England and Wales (Godwin, 1956) although there may be minor variations in placing the zone boundaries.

The results for the site as a whole are self-consistent, contiguous samples have closely similar dates, and the whole series of dates follows the stratigraphic sequence.

The separate samples are identified below by the depth in centimeters on the two pollen diagrams B and C in the publication cited. "Humification" (H) is reported in terms of the usual 10-point scale.

**Q-172. Scaleby 67 to 69 cm B 4987 ± 119**

2-cm slice of moderately humified *Sphagnum-Calluna* peat, H 6: just above Q-171.

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**Q-171. Scaleby 69 to 71 cm B 4932  $\pm$  134**

2-cm slice of moderately humified *Sphagnum-Calluna* peat, H 6. Zone VIIa/VIIb boundary at 70 cm. This boundary is generally taken to correspond with the Atlantic/Sub-boreal transition. A fall in *Ulmus* pollen to very low values is its most striking characteristic.

**Q-170. Scaleby 71 to 73 cm B 4994  $\pm$  122**

2-cm slice of moderately humified *Sphagnum-Calluna* peat, H 6: just below Q-171. A pronounced recurrence surface lies about 4 cm below this level in the monolith but was not recognized in the borings at this level.

**Q-166. Scaleby 174.5 to 176.5 cm B 6955  $\pm$  131**

2-cm slice of compact, rather well humified *Sphagnum-Calluna* peat, H 7, frequent remains of *Calluna* and occasional *Eriophorum vaginatum*: just above Q-165.

**Q-165. Scaleby 176.5 to 178.5 cm B 7432  $\pm$  ca. 350**

2-cm slice of peat as for Q-166, taken across the zone VI/VIIa boundary. This is generally regarded as the Boreal/Atlantic transition, here primarily indicated by the replacement of *Betula* by *Alnus* as the dominant tree pollen. Like Q-151, this sample was analyzed in a stainless steel counter with higher background and larger probable error than the other Scaleby determinations.

**Q-167. Scaleby 178.5 to 180.5 cm B 7361  $\pm$  146**

2-cm slice of peat as for Q-165 and just below that sample.

**Q-161. Scaleby -0.5 to 1.5 cm C 9009  $\pm$  194**

2-cm slice of rather well humified *Sphagnum-Calluna* peat taken across the zone V/VIa boundary, chiefly indicated by the very swift rise of *Corylus* pollen to high values.

**Q-162. Scaleby 3.5 to 5.5 cm C 8816  $\pm$  192**

2-cm slice of peat of same type as sample Q-161: below that sample but separated by gap of 2 cm. Upper zone V.

**Q-155. Scaleby 44.5 to 46.5 cm C 9747  $\pm$  183**

2-cm slice of light brown *Sphagnum* mud with abundant remains of *Equisetum* and *Menyanthes*: just above Q-154.

**Q-154. Scaleby 46.5 to 48.5 cm C 9564  $\pm$  209**

2-cm slice of peat as in sample Q-155, taken across the zone IV/V boundary. This is generally regarded as the Pre-boreal/Boreal transition, recognizable by sharp decrease in herbaceous and *Salix* pollen with great expansion of *Betula* (tree birches).

**Q-152. Scaleby 69.5 to 71.5 cm C 10,160  $\pm$  193**

2-cm slice of gray-brown coarse detritus mud, slightly clayey and silty with frequent stones: just above Q-151.

**Q-151. Scaleby 71.5 to 73.5 cm C 10,264  $\pm$  ca. 350**

2-cm slice of material as sample Q-152, taken across the zone III/IV boundary, i.e., the Late-glacial/postglacial transition. Recognized partly by the

change from mineral to organic strata (at ca. 67 cm) and partly by first signs of suppression of herbaceous pollen by that of trees. Determination in counter with high background as Q-165.

**Q-153. Scaleby 73.5 to 75.5 cm C 10,325 ± 215**

2-cm slice of material as in samples Q-152 and Q-151, and just below Q-151.

**Q-144. Scaleby 109.5 to 111.5 cm C 10,835 ± 185**

2-cm slice of medium brown, laminated, slightly silty fine detritus mud: just above Q-147. Base of zone III.

**Q-147, Q-148. Scaleby 123 to 127 cm C 10,705 ± 207**

Two slices each 2 cm thick from just below Q-144 and of similar material. Two samples bulked to give adequate amount of carbon. Top of zone II, equivalent to end of Allerød mild period, indicated by change from rather organic mud to a more mineral layer, and by some recession of tree and shrub pollen with corresponding increase of herbaceous pollen types.

*B. British Late-glacial Series*

Godwin and Willis (in press) have described the results of carbon-dating a series of samples from several widely spaced sites in Great Britain, at each of which stratigraphic and biological evidence (chiefly pollen analysis and identification of macroscopic plant remains) combine to establish the Late-glacial age of the deposits. The organic material comes chiefly from zone II, the mild Allerød stage; the combined results suggest that this lasted from about 12,000 to 10,800 B.P.

**Garral Hill series, Keith, Banffshire, Scotland**

On the south slope of Garral Hill (57° 37' N Lat, 2° 57' W Long, Nat. Grid Ref. NJ 444551) about 4 mi N of Keith ca. 550 ft (168 m) o.d., stream erosion exposed a section typical of the Late-glacial sequence, namely, silty *Hypnum* peat overlying dark brown silty clay with some organic content between two mineral layers of silt or silty clay with a few stones, apparently solifluxion material. Donner (1957) showed that pollen analyses of the organic middle layer had "great similarity with the Late-glacial diagrams from southwestern Scotland."

From an undisturbed column through the *Hypnum* peat Donner took four consecutive samples, and a fifth from the middle of the underlying clay mud. The results of the radiocarbon assay are given in Godwin and Willis (in press). Together they indicate a duration for zone II of the order of magnitude of 1000 yr.

**Q-104. Garral Hill 200 to 205 cm 10,808 ± 230**

5-cm slice of silty *Hypnum* peat: top of pollen zone II.

**Q-103. Garral Hill 205 to 210 cm 11,098 ± 235**

5-cm slice of silty *Hypnum* peat: just below Q-104.

**Q-102. Garral Hill 210 to 215 cm 11,308 ± 245**

5-cm slice of silty *Hypnum* peat: just below Q-103.

- Q-101. Garral Hill 215 to 220 cm 11,888  $\pm$  225**  
 5-cm slice of silty *Hypnum* peat: just below Q-102.
- Q-100. Garral Hill ca. 230 cm 11,358  $\pm$  300**  
 Silty clay mud of low carbon content so that sample had to be diluted with inactive CO<sub>2</sub>, giving a larger probable error.
- Q-284. Low Wray Bay, Windermere, Westmorland 11,878  $\pm$  120**  
 Cores taken from lake bed off the west shore in 3 m of water, 200 m NW of Watharrow Point (54° 54' N Lat, 2° 57' W Long). Pennington (1947) had shown that the Late-glacial succession was represented in Windermere by two layers of laminated glacial clay separated by a detritus silt. This recognition was supported by macrofossil identifications and by pollen analyses made at the time and later. To secure sufficient carbon the middle detritus silt from several cores was aggregated.
- Q-61. Lunds, Yorkshire—upper zone II 10,600  $\pm$  120**  
 A section exposed by erosion in the flank of a drumlin (54° 51' N Lat, 2° 19' W Long) displayed a mineral solifluxion layer above a layer of organic detritus muds. Pollen analyses by Walker (1955) confirmed the reference of these muds to zone II, the mild phase of the Late-glacial period. In 1953 H. Godwin collected for assay the upper 2 cm of the organic mud layer (Q-61), and the bottom 1.5 cm (Q-57).
- Q-57. Lunds, Yorkshire—base zone II 11,950  $\pm$  120**  
 Organic mud at base of zone II of the Late-glacial Period (see Q-61, above).
- Q-207. Neasham, Co. Durham—upper zone II 11,011  $\pm$  230**  
*Hypnum* peat (54° 20' N Lat, 1° 30' W Long.) Blackburn (1952) reported a basin in boulder-clay lined by laminated clays referable to zone I, and filled with organic muds and peats referable to zone II on the basis of extensive pollen analyses and macroscopic plant identifications. These deposits were sealed in by clays of zone III. A sample from the *Hypnum* peat at the top of zone II was collected by K. B. Blackburn, King's College, Newcastle-upon-Tyne, in 1949, and was dated by Libby in Chicago (C-444, 10,851  $\pm$  630; Libby, 1952). In 1951 H. Godwin collected sample Q-207 from the same layer.
- Q-208. Neasham, Co. Durham—zone II 11,561  $\pm$  250**  
 Silty detritus muds from near middle of zone II (see Q-207, above).
- Q-66. Flixton, Star Carr, Yorkshire 10,413  $\pm$  210**  
 Organic mud. At this site (54° 15' N Lat, 0° 4' W Long), bones of *Equus* had been found in an organic mud layer covered with solifluxion gravel. Both mud and gravel are referable on pollen-analytic and stratigraphic evidence (Walker and Godwin, in Clark, 1954) to the Late-glacial period. The dated sample is from the top of the mud layer and appears to be either late zone II or early zone III.
- Q-279. Aby Grange, Lincolnshire 11,205  $\pm$  120**  
 Moss peat (53° 18' N Lat, 0° 5' E Long). Suggate and West (in press)

have described a depression in boulder-clay containing organic clay muds and moss peat with the pollen assemblage characteristic of zone II of the Late-glacial period. The dated sample of moss peat was apparently free from allothonous coal fragments, such as contaminated some samples such as Q-238.

**Q-2. Hawks Tor, Cornwall Site 1, 9 ft 0 in. to 9 ft 4 in.  $11,071 \pm 180$**

*Hypnum* moss peat ( $50^{\circ} 33' \text{ N Lat}$ ,  $4^{\circ} 36' \text{ W Long}$ ). In the china-clay pits at Hawks Tor, Bodmin Moor, Cornwall, a typical Late-glacial stratigraphy was recognized and confirmed by pollen analyses and macroscopic plant identifications (Conolly, Godwin, and Megaw, 1950). A sample of peat coll. 1949 by H. Godwin from the middle of zone II was dated in Chicago (C-341,  $9861 \pm 500$ ; Libby, 1952), London (GL-27,  $9728 \pm 140$ ; Zeuner, 1955), and Cambridge (Q-2).

**Q-92. Helton Tarn, Northwestern Lancashire  $10,760 \pm 140$**

Organic clay mud ( $54^{\circ} 14' \text{ N Lat}$ ,  $2^{\circ} 52' \text{ W Long}$ ). Within a small rock basin Smith (1958) has described a typical Late-glacial sequence of organic clay mud (zone II) overlain by a stoneless clay (zone III). There is good pollen-analytic evidence. Multiple-shot sampling with a Hiller borer secured an adequate bulk sample for the zone II material as a whole.

**Q-16. Knocknacran, Co. Monaghan, Ireland  $14,367 \pm 300$**

Calcareous lake mud ( $53^{\circ} 56' \text{ N Lat}$ ,  $6^{\circ} 46' \text{ W Long}$ ), referred by collector, G. F. Mitchell, Trinity College, Dublin, to pollen zone II (Mitchell, 1951). The Chicago date is C-355, 11,  $310 \pm 720$  (Libby, 1952). Although the Chicago date corresponds with other NW European zone II dates, the Cambridge date is far too old, and it seems possible that, if this determination is correct, this is due to the hard-water error (Godwin and Willis, in press). The Cambridge determination was made upon the residual organic matter after acidic leaching of all carbonate from the sample: this consisted largely or wholly of remains of water plants.

**Q-71. St. Bees, Cumberland  $12,810 \pm 180$**

Detritus mud ( $54^{\circ} 29' \text{ N Lat}$ ,  $3^{\circ} 37' \text{ W Long}$ ). Erosion on the west Cumberland coast near St. Bees showed a brown detritus mud in a depression in the Middle Sands which themselves overlie boulder-clay. The mud was sealed in by gray gravelly clay, probably a solifluxion deposit. Pollen analyses (Walker, 1956b) showed clearly a climatic amelioration and deterioration comparable with the Allerød oscillation, and a floristic assemblage consonant with this. The radiocarbon date is apparently too old for this correlation, but the deposit is clearly an interstadial of the last stages of the last glaciation. It would be premature to equate it with the Bølling oscillation. There is evidence that exposures of peats and organic muds in the cliffs nearby are not necessarily of the same age. Coll. 1955 by D. Walker.

### *C. Coastal Peat Beds*

In a short note Godwin, Suggate, and Willis (1958) considered the radiocarbon dating evidence for the time of the great eustatic rise of ocean level caused by melting of the world's ice sheets at the end of the last glacial period.

**Q-120. Tealham Moor, Somerset 5412  $\pm$  130**

Clayey *Phragmites* peat (51° 13' N Lat, 2° 50' W Long). Sample taken from North Drain excavation at junction of lower estuarine clay and *Phragmites* peat close to present sealevel. Marks end of big eustatic rise of ocean level, pollen zone VIIa. Coll. August 30, 1955 by H. Godwin. Extensive stratigraphic investigations in the Somerset Levels (see Clapham and Godwin, 1948) make it certain that this sample is within 1 or 2 ft of present mean sealevel.

**Q-134. Burnham-on-Sea, Somerset 6262  $\pm$  130**

Clayey *Phragmites* peat (51° 14' N Lat, 3° 0' W Long). Recovered by dredging from -15 ft, o.d. Pollen analyses indicate formation in brackish-water conditions, that is, near to contemporary sealevel. The analyses also indicate an age in zone VIIa. This sample represents almost the end of the postglacial eustatic marine transgression in the Somerset Levels. Coll. 1955 by E. L. Kelt-ing, Somerset River Board, Bridgewater.

**Q-181. Hamworthy, Poole Harbour, Dorset, No. 2 Borehole 9298  $\pm$  100**

Fine detritus mud (50° 71' N Lat, 2° 0' W Long), immediately overlying Bagshot Beds, 42 ft (12.8 m) below o.d. Pollen-analytically referable to zone VIb. Coll. August, 1956 by D. Ranwell, Research Staff, Nature Conservancy, London.

**Q-105. Leman and Ower Banks, North Sea 8422  $\pm$  170**

Peat (53° 10' N Lat, 2° 0' E Long). From a peat bed lying in 120 ft of water in the North Sea off the Norfolk Coast, in 1932 a Mesolithic barbed point was recovered, embedded in peat. Other peat samples later recovered from near this place were analyzed by G. Erdtman and H. and M. E. Godwin (1933): they fall within pollen zone V, the early part of the Boreal period. If an allowance of 30 ft is made for subsequent tectonic lowering of this part of the southern North Sea, ocean level 8400 years ago must have been at least 90 ft below its present height, possibly rather close to that figure if the peat formed close to contemporary sealevel.

**Q-278. Fao (Khor-al-Amaya), Persian Gulf 9910  $\pm$  110**

Freshwater detritus mud (approximately 30° N Lat, 48° 30' E Long). This was obtained by boring at 104 ft below present sealevel and appears to represent an organic layer of fairly wide extent at this level. It seems likely that in this region extensive marshes could only form close to contemporary ocean level, so that the radiocarbon date may be used as index to the post-glacial eustatic marine transgression (Godwin, Suggate, Willis, 1958). Coll. 1957 by Messrs. G. Wimpey and Co., Ltd.

*D. Further British Pollen-dated Levels***Q-19. Clonsast, Co. Offaly, Ireland 8264  $\pm$  225**

Peat (53° 14' N Lat, 7° 10' W Long), identified as from the Late Boreal pollen zone VIc when collected 1949 by G. F. Mitchell, Trinity College, Dublin (see Mitchell, 1951). Chicago date C-358, 5824  $\pm$  300 (Libby, 1952). Q-19 is part of the same sample, and the dating corresponds with just before the middle of zone VI on the Scaleby Moss dated zone sequence.

**Q-14. Star Carr, Yorkshire 9557  $\pm$  210**

Wood (54° 14' N Lat, 0° 37' W Long), from excavated platform of extensive Mesolithic occupation. Pollen-analytically attributed (Walker and Godwin, in Clark, 1954) to the zone IV/V transition. *Comment:* two Chicago datings for the same samples give an assay in close agreement: C-353, 9488  $\pm$  350 (Libby, 1952). The IV/V transition on the Scaleby Moss dated zone sequence is close to 9600 B.P. Coll. 1949 by H. Godwin.

**Q-141. Stump Cross, near Grassington, Yorkshire 6500  $\pm$  310**

Organic mud (54° 43' N Lat, 1° 53' W Long, Nat. Grid Ref. 082640). At an altitude of 1200 ft (365 m) on the Yorkshire moors, flint artifacts of a Tardenoisian (Mesolithic) industry were discovered stratified into the undisturbed organic muds of a small pool. Pollen analyses (Walker, 1956a) referred the industry to a time between the beginning and the middle of pollen zone VIIa. The dating sample was contemporary charcoal coll. 1956 by D. Walker. *Comment:* the date falls within the Scaleby Moss dates for the first half of zone VIIa. This is the first effective dating and pollen-zone reference for a very extensive microlithic industry that has hitherto been found only beneath the general spread of blanket bog on the Pennines.

**Q-310. Fordy, Little Thetford trackway, Cambridgeshire 2560  $\pm$  110**

Oak wood (52° 21' N Lat, 0° 16' W Long). Where the Isle of Ely most closely approaches the uplands a wooden trackway with massive piles was discovered by T. Lethbridge and G. Fowler. Late Bronze Age or Early Iron Age artifacts were discovered in apparent relation to the causeway, which appeared to have been used in pollen zone VII/VIII (Godwin, 1940). In 1958 a wooden oak pile from the same trackway was collected and submitted by J. G. D. Clark, University Department of Archaeology, Cambridge. Only the outermost rings of the wood were dated, but even so the felling date must be a few years older. There is evidence for other Late Bronze Age trackways in this part of the East Anglian Fenland, possibly built in response to worsening climate and wetter conditions.

**Somerset Levels series, Southwestern England**

During the last 20 years several corduroy trackways of diverse construction have been uncovered in the course of peat-cutting in the derelict raised bogs of the Somerset Levels. Intensive examination of several of them showed that they all lay at the same pollen-analytic zone boundary. Moreover, they were all laid down upon the upper surface of a very dark, highly humified *Sphagnum-Eriophorum-Calluna* peat, and all of them were immediately overlain by a peat type indicative of widespread flooding, in many instances by a *Cladium-Hypnum* peat that could only reflect submergence of the peat bogs by calcareous water from the surrounding Mendip and Polden Hills. Whereas the old raised-bog surfaces were clearly in a phase of slow growth or arrest, during which their heather-clad surfaces could easily be crossed by men living on the hillslopes and islands, the flooding imposed extremely circuitous and difficult routes to reach the Mendips or the Wedmore Ridge from the Poldens. It was conjectured, therefore, that the flooding episode actually induced the construc-

tion of the wooden trackways, but was itself so severe and extended that the newly built tracks were submerged before they were much damaged by wear or decay.

Upon the timbers of several of the tracks were recognized the outlines of axe cuts of the small thick axes of the Late Bronze Age, and this dating was supported by the discovery at two sites of Middle to Late Bronze Age spears at roughly comparable horizons in the peat sequence.

A complex of changes appeared to be strongly associated: a change in general forest composition reflected in the pollen diagrams, a recession in the regional agriculture shown in the pollen diagram by pollen of weed plants, a pronounced change in the bog stratigraphy indicative of widespread flooding, and a sudden outburst of trackway-building and quick abandonment. It was difficult to resist the inference, supported by the evidence of the axe markings, that we were here concerned with the effects of the "Sub-boreal, Sub-atlantic climatic deterioration" that had been held responsible by Weber for the widespread *Grenzhorizont* or recurrence surface, in the raised bogs of Western Europe (Clapham and Godwin, 1948; Godwin, 1948). Only the first four trackways dated below have as yet been described.

**Q-52. Meare Heath track (Bulleid's) 2840 ± 110  
2850 ± 110**

Shaped wooden stake from massive prehistoric trackway crossing Meare Heath, Somerset (51° 9' 20" N Lat, 2° 48' 15" W Long). Originally described by A. Bulleid. When recovered later (Clapham and Godwin, 1948), the track was found to lie near the upper surface of the highly humified *Sphagnum-Calluna* peat. Pollen analyses showed changing local conditions of the bog surface and placed the trackway in the transitional zone VII/VIII. Although some massive timbers of this trackway were probably derived from older constructions, this shaped stake is more likely to be contemporary.

**Q-39. Shapwick Heath track (Foster's) Site b 2470 ± 110**

Hazel stems from a slight wooden trackway first encountered (51° 9' N Lat, 2° 48' W Long) in 1942 and rediscovered in 1955. Stratigraphy and pollen analyses showed almost exactly the same situation as at the Meare Heath track (Clapham, and Godwin, 1948). Coll. September 13, 1953 by H. Godwin from a later exposure of the track.

**Q-308. Westhay track (Sandford's) 2800 ± 110**

Average of two results. Large horizontal birch timber marked with axe cuts of Late Bronze Age type, from a massive trackway (ca. 51° 10' N Lat, 2° 49' W Long), discovered in 1943 and excavated in 1944 (Clapham and Godwin, 1948). The sample illustrated as figure 23 B in the paper cited was kept in alcohol as a museum specimen until 1958. It was then vacuum-dried and baked to get rid of the alcohol, and combusted for assay. Stratigraphy and pollen analyses showed broadly the same relationships as the Meare Heath and Shapwick Heath tracks. A bronze spear was found nearby at a slightly lower stratigraphic horizon than the trackway. Coll. 1944 by H. Godwin and A. R. Clapham.



**Q-306. Blakeway Farm track 2600 ± 110**

Hazel stem from slight trackway running north/south between Mudgley and Westhay (51° 11' 30" N Lat, 2° 48' W Long). This track was made of successive faggots of straight hazel rods pinned down by occasional stakes. It was excavated in 1944 (Clapham and Godwin, 1948) but was encountered again 0.5 mi S. Here the assay sample was collected by H. Godwin in 1947 from horizontal timber in situ.

**Q-7. Viper's track A, Shapwick Heath 2520 ± 110**

Vertical pile of *Acer campestre* L. from trackway (51° 9' 20" N Lat, 2° 49' 10" W Long). This north/south trackway was first recorded in 1947; it was later excavated and measured by H. S. L. Dewar. It has been carefully related to the stratigraphy and pollen zones (unpublished), displaying close resemblance to the relationships exhibited by the other trackways. Some of its timbers also exhibited Late Bronze Age axe work. Coll. October 2, 1949 by H. Godwin from the excavation site.

**Q-312. Viper's track A, Shapwick Heath 2630 ± 110**

Miscellaneous small constructional wood from same trackway as Q-7 (51° 9' 20" N Lat, 2° 49' 10" W Long), but encountered again after the 1949 excavation, and at a site between the first and second recorded exposures. Coll. September, 1953, by H. Godwin from peat-cutting face.

**Q-311. Viper's Platform, Shapwick Heath 2410 ± 100**

Small timber recovered from the structure of a small platform or miniature crannog (one of several ca. 51° 9' 48" N Lat, 2° 49' 5" W Long), disclosed by peat-cutting, and noted by H. Godwin, P. A. Tallentire, and J. N. Jennings in July, 1947. The purpose of the platforms is unknown. It was shown that they bore the same relationship to the raised-bog stratigraphy and pollen zonation as the wooden trackways. Sample coll. 1947 by H. Godwin and kept subsequently in alcohol which was removed before carbon dating was attempted.

**Q-309. Blakeway Farm track (subjacent peat) 2790 ± 110**

Highly humified *Sphagnum-Calluna* peat on which the trackway (51° 11' 30" N Lat, 2° 48' W Long) was resting. Coll. 1947 by H. Godwin with Q-306.

**Q-44. Shapwick Heath track (peat 2 to 4 in. below track) 3310 ± 110**

Highly humified *Sphagnum-Calluna* peat from 2 to 4 in. below horizontal wood of the trackway (51° 9' N Lat, 2° 48' W Long). Coll. September 13, 1953 by H. Godwin with Q-39.

**Q-53. Meare Heath track (subjacent peat) 3230 ± 110**

Strongly laminated pool peat with *Sphagnum cuspidatum* on the surface of the old highly humified *Sphagnum-Calluna* peat and just below a main timber of the trackway (51° 9' 20" N Lat, 2° 48' 15" W Long). Coll. with Q-52.

**Q-36. Shapwick Heath track, site b (1st oligotrophic layer) 2250 ± 110**

A tree stump of *Betula* at the trackway exposure (51° 9' N Lat, 2° 48' W

Long). Coll. 1953 by H. Godwin in the unhumified *Sphagnum* peat above the *Cladium-Hypnum* peat of the first flooding episode, the presumed reason for the building of the wooden trackways.

#### *General Comment on Somerset Levels Series*

The radiocarbon dates for the five trackways and the platform all fall between 2470 and 2850 B.P. They thus confirm the hypothesis that they were built as a response to a single episode, a major flooding of the raised bog. Moreover, the Late Bronze Age date suggested by the axe markings and stratigraphic position of two bronze spear discoveries is confirmed also. It is notable that this pronounced flooding episode falls at a primary pollen-zone boundary, the transition between zones VII and VIII. This seems to be an instance supporting the reality of a pronounced climatic change of the right kind and date to be correlated with Weber's original *Grenzhorizont*, and Granlund's RY III. Note also in this connection the similar date of the Cambridgeshire trackway, Q-310 (this date list).

The samples Q-309, Q-44, and Q-53 are peat samples from immediately below those of the trackways. In each instance these samples are older than the trackway timber, in two cases very markedly so. This raises the possibility, already indicated by the nature of the peat, that the bogs may have been in a stage of *Stillstand* or erosion before they were inundated, and that, either then or during the flooding, some of the surface peat was lost. This calls for closer field investigation.

Sample Q-36 comes from the oligotrophic peat that formed after the major flooding episode just mentioned. It is some 300 years younger than the trackways, and its date agrees with the nearby discovery of a bronze fibula provisionally referred to a period A.D. 0 to 50, and found in the next higher stratum of peat (Godwin, 1954).

#### *E. Checks and Problematic Dates*

A number of determinations have been done primarily to check the performance of the apparatus, or in pursuit of the explanation of errors. It has seemed appropriate to group these here: some sources of error have been considered by Godwin and Willis (in press).

##### **Q-112. Lake Nemi, Italy**

**1904  $\pm$  95**

Timber (41° 43' N Lat, 12° 42' E Long), recovered from boat made for the Emperor Caligula in A.D. 37 to 41. Sample subm. 1955 by A. C. Blanc and C. Cortesi, Istituto di Geochimica dell'Università, Rome. Sample also dated in Stockholm (St-103A.B. 2010  $\pm$  65; Östlund, 1957), by the British Museum (BM-15. 2080  $\pm$  150; Barker and Mackey, 1959), and in Uppsala (U-68, 1980  $\pm$  70; Olsson, 1959).

##### **Q-238. Aby Grange, Lincolnshire (cf Q-279)**

**12,870  $\pm$  180**

The unexpectedly great age of this peat (53° 18' N Lat, 0° 5' E Long), from a zone II Late-glacial sample is confidently attributed to comminuted coal derived from the surrounding boulder-clays. This is a very likely source of

error in water-laid deposits in the north of England (cf sample Q-279, free from secondary material).

**Q-40. Lunds, Yorkshire (cf Q-57) 8728  $\pm$  180**

Peat (54° 51' N Lat, 2° 19' W Long), immediately above the zone III solifluxion soil was sampled for carbon dating. Pollen analyses (Walker, 1955) had indicated that it formed in zone VIIa. This makes the determined date understandable but shows that a long time gap intervened before peat accumulated over the zone III mineral soils.

**Q-1. Hawks Tor, Cornwall, Site 1, 7 ft to 7 ft 4 in. 7770  $\pm$  100**

Peat (50° 33' N Lat, 4° 36' W Long), immediately above the zone III solifluxion soil, was sampled for carbon dating. The Cambridge datings as well as the two Chicago datings for the same sample (C-340, 8011  $\pm$  400, 8450  $\pm$  780; Libby, 1952) show that there is a depositional hiatus above the mineral layer until about 6000 B.C. Pollen-analytic data are now seen to accord with this date, although initially a different interpretation had been (tentatively) adopted.

**Q-3. Hawks Tor, Cornwall, Site 1, 7 ft 7 in. to 7 ft 11 in. 8190  $\pm$  180**

A sample of silty mud (50° 33' N Lat, 4° 36' W Long), coll. 1949 by H. Godwin, as representing the solifluxion gravels of zone III of the Late-glacial. The date is much too young for zone III, and it is evident that, long after the solifluxion soil had been laid down, the onset of peat accumulation during zone VI involved some incorporation of organic mud in the gravels (see comments on Q-1 and Q-2).

**Moss Lake series, Liverpool**

At Moss Lake, Liverpool (53° 25' N Lat, 2° 59' W Long), a large raised bog overgrew a lake basin at the base of which were Late-glacial deposits exhibiting the characteristic threefold stratigraphy. Intensive pollen analyses and identifications of abundant macroscopic plant remains confirmed this and allowed the vegetational history of the deposits to be followed from zone I to zone VIIa of the English pollen zone sequence (Godwin, 1959).

Nevertheless radiocarbon dating of the organic detritus muds of zone II, the base of zone IV, and the zone V/VI transition gave values which were far too young.

**Q-218. Moss Lake, Liverpool—lower zone II 7300  $\pm$  120**  
Mean of two measurements.

**Q-217. Moss Lake, Liverpool—lower zone II 7550  $\pm$  120**  
Mean of two measurements.

**Q-193, Q-194. Moss Lake, Liverpool—lower zone IV 6090  $\pm$  120**

**Q-201. Moss Lake, Liverpool—zone V/VI transition 8175  $\pm$  120**  
**8295  $\pm$  120**

The explanation of these results seems to be that at some time in the history of the bog colloidal humic material moved down in solution from the *Sphagnum-Calluna* peat into the slightly calcareous lake deposits beneath, and was there precipitated. This recalls the way "dy" is precipitated when bog streams discharge into calcareous lakes. To test this hypothesis a bulk sample of the zone II detritus muds was leached with caustic soda, and the humic extract was reprecipitated, washed, and dated:

**Q-220, Q-221. Moss Lake, Liverpool 7550 ± 120**

Colloidal humic material extracted from zone II detritus muds. *Comment:* Instead of an expected age of between 10,800 and 12,000, the age of the extracted humate corresponds with late zone VI in the Scaleby Moss dated zone sequence. This is a period of low lake levels and dried-out bog surfaces throughout Britain, and it may have been material of this age that penetrated into the deeper lake deposits, incidentally cementing these and giving them a pronounced chocolate-brown color. It is not known when the down-movement took place and it may have been not until the bog was drained and overbuilt in the last century.

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