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## Site 25 Knockhill Wood, Glenbervie

A Late-glacial (Windermere) Interstadial peat, intercalated between red-brown diamictons at Knockhill Wood, Glenbervie (Map 10), provides important evidence of the age of slope modification in Strathmore by landslipping. The  $^{14}\text{C}$  age, pollen spectra and plant macrofossils obtained from the peat, and its stratigraphical contacts suggest that the last movement occurred either during the Loch Lomond Stadial or when the climate ameliorated, during the earliest Holocene.

A composite organic deposit was discovered beneath reddish brown diamicton of the Mearns Drift Group during the resurvey of Sheet 66E Banchory in 1989. The deposits were located in a drainage ditch [NO 7667 8012] on the north-eastern side of a forestry track through Knockhill Wood, on the southern side of the valley of the Bervie Water, upstream of Glenbervie (Figure A1.30). The organic sediments consisted largely of peat, with subordinate layers of fine peaty sand and laminated clayey silt (Table A1.15). They rested upon an unstratified bouldery till, also reddish brown in colour.

The organic deposits are exposed along about 7 m of the ditch, and appear to form a wedge in the side of Knock Hill (Figure A1.31). They overlie bouldery till (unit J of (Table A1.15)) and are interstratified with clayey silts and sands. At the north-eastern end of the section, the upper part of the organic sequence (units B–F) is truncated by the overlying clayey diamicton of unit A. This diamicton is hard, but plastic, and apart from flecks of more vivid red clay, it shows little sign of internal stratification. Its base is slightly uneven and gradational over about 1 cm. Other sections lower down the hillside show that the basal till (unit J) reaches up to 8 m in thickness and varies laterally from being stiff and clayey, to friable and sandy. It rests on decomposed feldspathic andesite of the Montrose Volcanic Formation in a river cliff of the Bervie Water [NO 7642 8024].

The base of unit A incorporates wisps and fragments of peat where it overlies the truncated stretch of the organic sequence. The organic sequence itself is penetrated to a depth of about 0.8 m by a vertical, downward-tapering crack filled with red-brown clayey diamicton (Figure A1.31). The crack is either an ice-wedge pseudomorph, or a vertical fracture that has opened up owing to down-slope gravitational movement. The latter explanation is perhaps more likely as there is no evidence of any reorientation of clasts within the fissure infill, as would be expected if it were of periglacial origin.

Six samples taken from a monolith (Figure A1.32) for pollen analysis by M J C Walker (University of Wales, Lampeter, 1989), yielded relatively sparse assemblages. Only one hundred pollen grains were counted from each sample (Table A1.16). The pollen assemblages suggest an open, essentially treeless landscape, dominated by grass and sedge, with a number of herbaceous taxa present (e.g. *Compositae*, *Cruciferae*, *Rumex* and *Caryophyllaceae*). Tree pollen was sparse, although willow pollen was notable towards the bottom of the profile. The treeless nature of the landscape suggested by these assemblages is clearly indicative of interstadial or tundra climate, rather than warmer interglacial conditions.

The climatic inferences from the pollen analyses were supported by the results of plant macrofossil analysis by M Field (Keele University, 1991) (see (Figure A1.32) for sampling intervals). Sample B9 yielded 34 compressed *Carex* (sedge) fruits. Sample B10 yielded a well-preserved assemblage of macrofossils, but revealed the presence of only three taxa. A single seed of *Viola* sp. (violet), 81 compressed *Carex* fruits and hundreds of seeds of *Monitia fontana* subspecies *fontana*, a herbaceous annual to perennial of the 'Blinks' family (Stace, 1991) were recorded. The latter form is widely distributed at present in northern Britain and reaches north-westwards into northern Scandinavia. It occurs in damp habitats and its occurrence with *Carex* suggests a damp open landscape.

An initial radiocarbon age (GX-14723) of  $12\,460 \pm 130$   $^{14}\text{C}$  years BP was obtained for an acid-washed bulk sample of the silty peat. A sample taken subsequently was pre-treated to separate the alkali soluble (humic) and alkali insoluble (humic) components for independent age measurement. This was undertaken in order to identify any younger contaminants not completely removed by the pre-treatment. An age of  $12\,305 \pm 50$   $^{14}\text{C}$  years BP was obtained for the

humic component (SRR–3687a) and  $12\,340 \pm 50$   $^{14}\text{C}$  years BP for the humin component (SRR–3687b) (Table 8). All of the radiocarbon dates indicate a Late-glacial Interstadial age for the lower part of the sequence. It is possible that the upper parts of the organic sequence may extend into the succeeding Loch Lomond Stadial, but at present, the evidence from the flora is inconclusive.

The stratigraphical, sedimentological and palaeontological studies of the sequence at Knockhill Wood and the radiocarbon dates suggest that the organic sediments were laid down in a cool damp environment, during the Late-glacial (Windermere) Interstadial. The organic sequence overlies a basal bouldery lodgement till of probable main Late Devensian age, laid down on top of weathered andesite bedrock. The basal till is assigned to the Mill of Forest Till Formation (Chapter 8). The origin of the overlying matrix-supported clayey diamicton is more problematic. Its compact structure and absence of well-developed internal stratification are typical attributes of lodgement or deforming-bed tills, rather than flow tills. No tills of Loch Lomond Stadial age are known from the district. Indeed, dating and palynological evidence from sites such as the Loch of Park indicate that the low ground was deglaciated throughout the Loch Lomond Stadial.

The upper diamicton has a gradational, but apparently conformable contact with the underlying organic sediments in the south-western part of the Knockhill Wood section, but it sharply truncates the upper part of the same sequence at the north-eastern (downslope) end of the exposure. This cross-cutting relationship, together with incorporation of fragments of peat in the till near the truncation surface, suggest that the diamicton has been emplaced as part of a landslide. The slip occurred by downslope movement along a gently curved, low-angle plane at the top of the laminated clayey silts (Figure A1.33). It is likely that slipping also occurred at the till/bedrock contact. If the tapering feature cutting the organic sequence is an ice-wedge cast, its presence would suggest that the movement probably occurred immediately following the Loch Lomond Stadial when rapid climatic amelioration took place.

**(Table A1.15) Stratigraphy of the Knockhill Wood site.**

Unit	Lithology	Description	Thickness (m)	Depth (m)
A	Landslipped till	Diamicton, stiff, clayey, slightly sandy; moderate reddish brown, 'flecked' with red. Clasts angular to subangular, gravel including decomposed andesite. Slightly irregular gradational base	0.25	0.25
B	Clayey silt	Clayey silt, with sand laminae and thin wisps of peat. Light olive-grey to pale reddish brown. Sharp planar base	0.05	0.30
C	Fibrous peat	Peat, fibrous, compact, with pronounced colour banding on freshly exposed face. Colour ranges from moderate yellowish brown, through dusky yellowish brown to black. Slightly irregular base	0.51	0.81

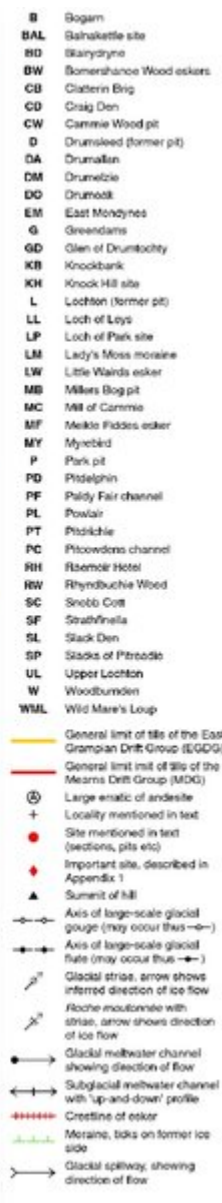
D	Clayey silt	Clayey silt, micaceous, with fine sand and some peat fragments. Dark yellowish brown to moderate greyish red. Uneven base	0.07	0.88
E	Fibrous peat	Peat, fibrous, dark yellowish brown to dusky yellowish brown	0.10	0.98
F	Silty peat	Peat, silty, laminated, moderate grey	0.06	1.04
G	Sand	Sand, silty and clayey, medium- to coarse-grained, greyish red. Some small peat lenses incorporated towards the base	0.16	1.20
H	Silty peat	Peat, silty and clayey, moderate olive-grey	0.05	1.25
I	Fibrous peat	Peat, fibrous, dark yellowish brown to dusky yellowish brown Diamicton, firm, sandy and silty, moderate reddish brown. Clasts rounded to well	0.02	1.27
J	Till	rounded, large cobbles and boulders derived from Old Red sandstone conglomerates	0.15+	1.42

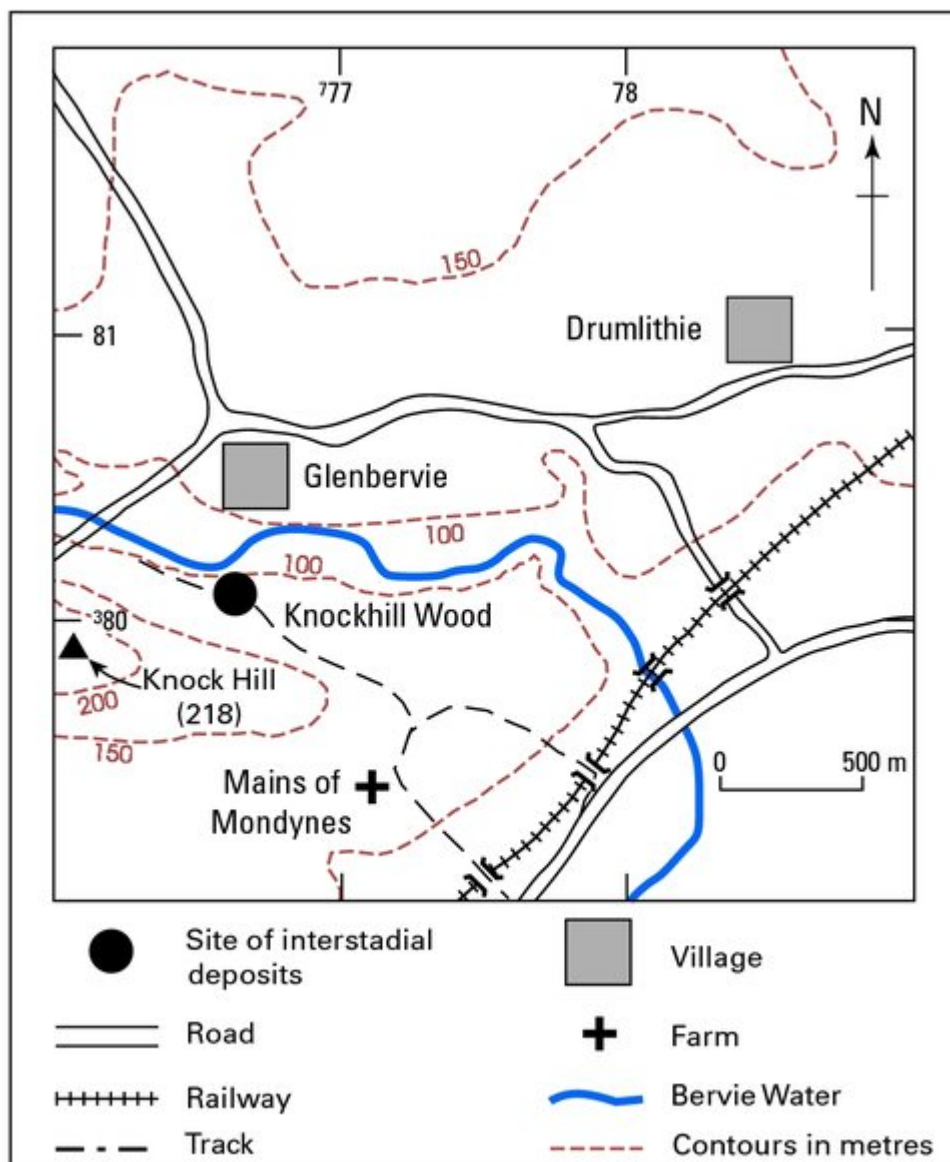
**(Table A1.16) Outline pollen count from Knockhill Wood.**

	Sample	1	2	3	4	5	6
Trees	Betula (birch)			1	1	1	1
Trees	Pinus (pine)	2	2	1			1
Shrubs/dwarf shrubs	Corylus (hazel)		1				
Shrubs/dwarf shrubs	Salix (willow)	7	4	4		1	1
Shrubs/dwarf shrubs	Ericaceae (heather)					1	2
Shrubs/dwarf shrubs	Empetrum (crowberry)				3	1	
Grass	Gramineae						
Sedges	Cyperaceae	28	32	26	14	14	28
Herbaceous taxa	Compositae: Liguilflorae (daisy)	1	1	4	1	1	

Herbaceous taxa	Compositae: Tubliflorae (daisy)		19	1			
Herbaceous taxa	Caryophyllaceae (pinks)	1	1	3	1		
Herbaceous taxa	Cruciferae (brassica)	12	11	2	4	1	
Herbaceous taxa	Enilobiusn (willowherb)	1	1				
Herbaceous taxa	Ranunculus (buttercup)	1	1	2			
Herbaceous taxa	Rumex (docks)	8	3	2	3		10
Herbaceous taxa	Thalictrum, (meadow-rues)		4		1	1	
Herbaceous taxa	Artemesia (mugworts)		2				1
Aquatics	Myriophyllum (water-milfoils)					1	
Aquatics	Potamogeton (pondweeds)		1	3			
Spores	Filicales	7	11	10	5		
Spores	Lycopodium					4	
Spores	Lycopodium selago					1	
Spores	Sphagnum						165
	Indeterminate	6	3	4	3	2	2
	Depth (cm)	104-107	97-104	81-84	57-67	45-50	25-30

## [References](#)

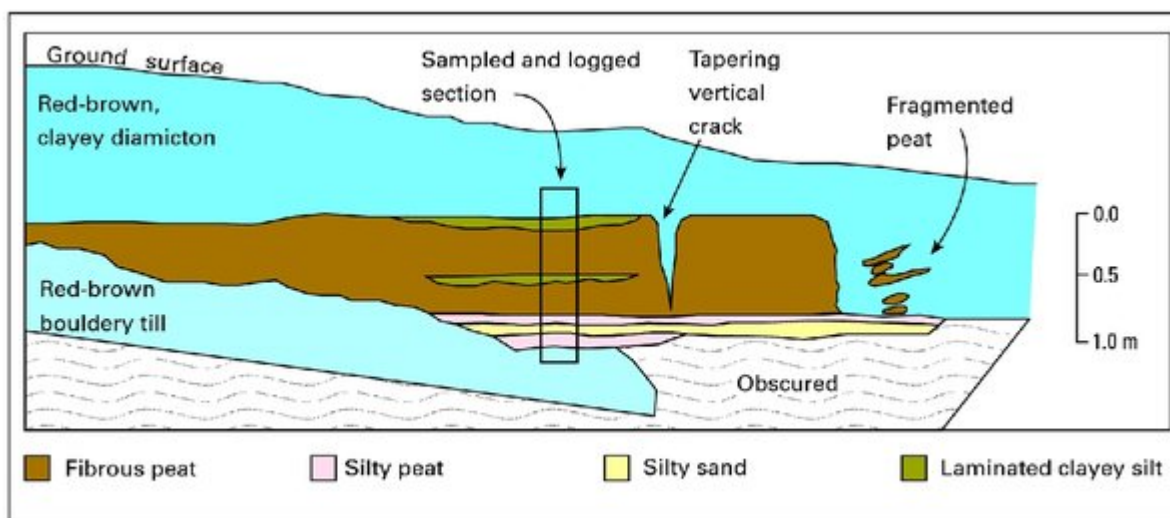




(Figure A1.30) Location of Knockhill Wood site.

Unit	Lithology	Description	Thickness (m)	Depth (m)
A	Landslipped till	<b>Diamicton</b> , stiff, clayey, slightly sandy; moderate reddish brown, 'flecked' with red. Clasts angular to subangular, gravel including decomposed andesite. Slightly irregular gradational base	0.25	0.25
B	Clayey silt	<b>Clayey silt</b> , with sand laminae and thin wisps of peat. Light olive-grey to pale reddish brown. Sharp planar base	0.05	0.30
C	Fibrous peat	<b>Peat</b> , fibrous, compact, with pronounced colour banding on freshly exposed face. Colour ranges from moderate yellowish brown, through dusky yellowish brown to black. Slightly irregular base	0.51	0.81
D	Clayey silt	<b>Clayey silt</b> , micaceous, with fine sand and some peat fragments. Dark yellowish brown to moderate greyish red. Uneven base	0.07	0.88
E	Fibrous peat	<b>Peat</b> , fibrous, dark yellowish brown to dusky yellowish brown	0.10	0.98
F	Silty peat	<b>Peat</b> , silty, laminated, moderate grey	0.06	1.04
G	Sand	<b>Sand</b> , silty and clayey, medium- to coarse-grained, greyish red. Some small peat lenses incorporated towards the base	0.16	1.20
H	Silty peat	<b>Peat</b> , silty and clayey, moderate olive-grey	0.05	1.25
I	Fibrous peat	<b>Peat</b> , fibrous, dark yellowish brown to dusky yellowish brown	0.02	1.27
J	Till	<b>Diamicton</b> , firm, sandy and silty, moderate reddish brown. Clasts rounded to well rounded, large cobbles and boulders derived from Old Red sandstone conglomerates	0.15+	1.42

(Table A1.15) Stratigraphy of the Knockhill Wood site.

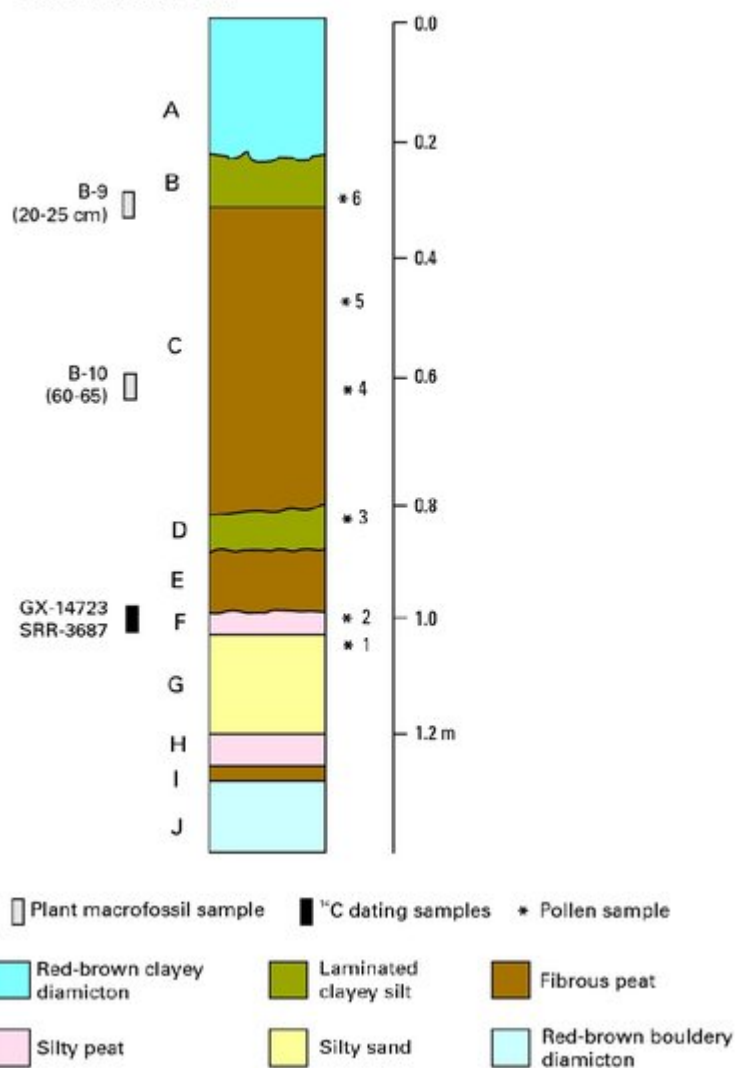


(Figure A1.31) Sketch transect of the Knockhill Wood exposure showing the relationship between the organic and glacial sediments.



KNOCKHILL WOOD SECTION, GLENBERVIE  
[NO 7667 8012]

Surface level: 112.38m



(Figure A1.32) Graphic log of the organic sequence at Knockhill Wood.

Sample	Depth (cm)	Trees		Shrubs/dwarf shrubs			Grass	Sedges	Herbaceous taxa							Aquatics	Spores									
		<i>Betula</i> (birch)	<i>Pinus</i> (pine)	<i>Corylus</i> (hazel)	<i>Salix</i> (willow)	Ericaceae (heather)	<i>Empetrum</i> (crowberry)	Gramineae	Cyperaceae	Compositae: Liguliflorae (daisy)	Compositae: Tubuliflorae (daisy)	Caryophyllaceae (pink)	Cruciferae (brassica)	<i>Epilobium</i> (willowherb)	<i>Ranunculus</i> (buttercup)	<i>Rumex</i> (docks)	<i>Thalictrum</i> (meadow-rue)	<i>Artemisia</i> (mugwort)		<i>Myriophyllum</i> (water-milfoil)	<i>Potamogeton</i> (pondweeds)	Filicales	<i>Lycopodium</i>	<i>Lycopodium selago</i>	<i>Sphagnum</i>	
6	25-30	1	1		1	2		28	54							10									2	
5	45-50	1			1	1	1	14	75	1		1	1				1		1				4	1	165	2
4	57-67	1					3	14	65	1	1	3	4				1				5				3	
3	81-84	1	1		4			26	34	4	19	1	2		2	2	1		1		10				4	
2	97-104		2	1	4			32	34	1		1	11	1	1	3	4	2	3		11				3	
1	101-107		2		7			28	34	1			12	1	1	8				1	7				6	

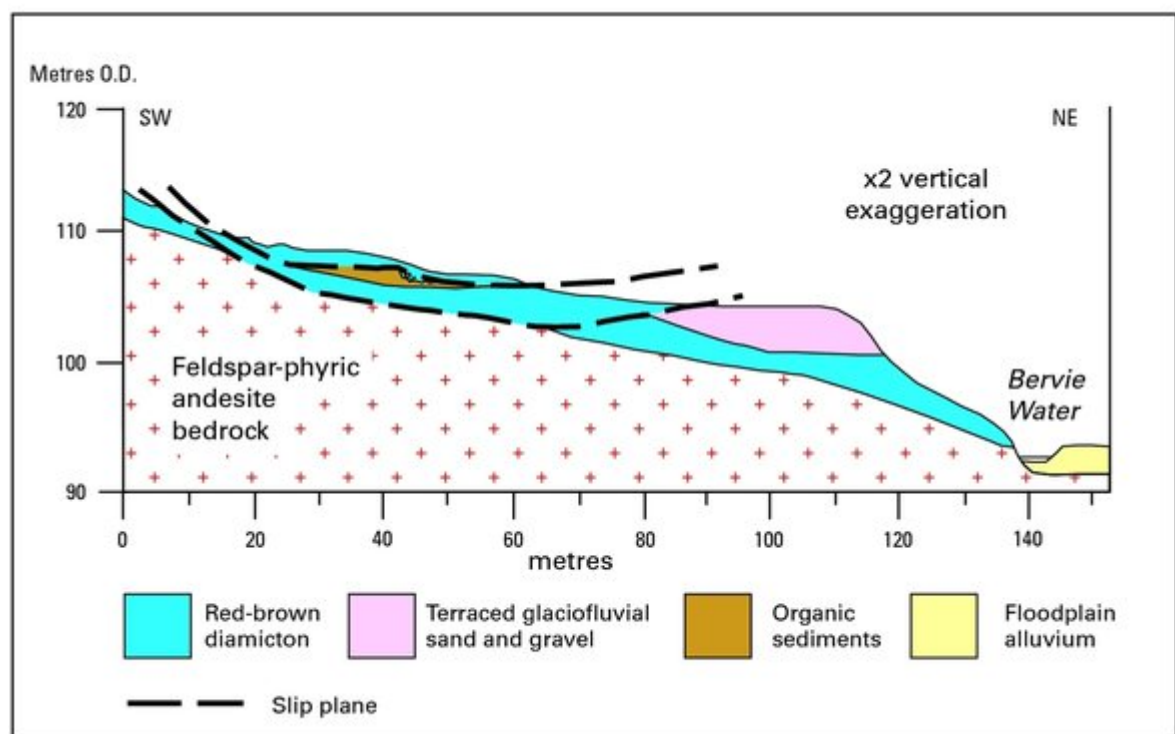
Analysis by MJC Walker, University of Wales, Lampeter, 1989  
Pollen sum = 100 land pollen

(Table A1.16) Outline pollen count from Knockhill Wood.



Site	Grid reference	Laboratory number	Age (years BP)	Dated material and setting	Reference
Roths cutting	NJ 277 498	Beta-85532	11 110 ± 70	peat under remobilised till	Appendix 1
Carra Hill, Keith	NJ 444 551	Q-104	10 808 ± 230	peat under remobilised till	Godwin and Willis (1959)
Carra Hill, Keith	NJ 444 551	Q-103	11 098 ± 235	peat under remobilised till	Godwin and Willis (1959)
Carra Hill, Keith	NJ 444 551	Q-102	11 308 ± 245	peat under remobilised till	Godwin and Willis (1959)
Carra Hill, Keith	NJ 444 551	Q-101	11 888 ± 225	peat under remobilised till	Godwin and Willis (1959)
Carra Hill, Keith	NJ 444 551	Q-100	11 358 ± 300	peat under remobilised till	Godwin and Willis (1959)
Woodhead, Fyvie	NJ 788 384	SRR-1723	10 780 ± 50	peat under remobilised till	Connell and Hall (1987)
Howe of Byth	NJ 822 571	SRR-4830	11 320	peat beneath gravel	Hall et al. (1995)
Moss side, Turves	NJ 833 318	I 6969	12 200 ± 170	peat under remobilised till	Clapperton and Sugden (1977)
Loch of Park	NO 772 988	IHEL-416	10 280 ± 220	kettlehole infill	Vasari and Vasari (1968)
Loch of Park		HEL-417	11 900 ± 260	kettlehole infill	Vasari and Vasari (1968)
Mill of Dyce	NJ 8713 1496	SRR-762	11 550 ± 80	kettlehole infill	Harkness and Wilson (1979)
Mill of Dyce	NJ 8713 1496	SRR-763	11 640 ± 70	kettlehole infill	Harkness and Wilson (1979)
Glenbervie	NO 767 801	CX-14723	12 460 ± 130	peat under remobilised till	Appendix 1
Glenbervie	NO 767 801	SRR-3687a (humic)	12 305 ± 50	peat under remobilised till	Appendix 1
Glenbervie	NO 767 801	SRR-3687b (humic)	12 340 ± 50	peat under remobilised till	Appendix 1
Brindieshill Farm	NO 7936 7918	SRR-387	12 390 ± 100	peat under remobilised till	Autou et al. (2000)
Rothens	NJ 638 171	SRR-3803	10 680 ± 100	kettlehole infill	Appendix 1
Rothens	NJ 638 171	SRR-3804	11 640 ± 160	kettlehole infill	Appendix 1
Rothens	NJ 638 171	SRR-3805	11 760 ± 140	kettlehole infill	Appendix 1

(Table 8) Radiocarbon dates from Late-glacial sites in the district.



(Figure A1.33) Postulated form of the landslide Knockhill Wood.