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REINDEER IN THE SCOTTISH QUATERNARY

By T.J. Lawson

Recent research by the author into the Quaternary of the Assynt area, north-west Scotland (Lawson 1983) necessitated a reassessment of the faunal remains discovered in previous excavations in the Creag nan Uamh caves, near Inchnadamp (Peach & Horne 1892, 1917; Callender et al. 1927; Lawson 1981). Amongst the large quantity of faunal material hitherto preserved in the Royal Scottish Museum, Edinburgh, were the abundant remains of reindeer (*Rangifer tarandus* Linné). In order to put this material into context, an extensive search of the literature was made in an attempt to determine the distribution, both temporal and spatial, of recorded reindeer remains from Scotland. The results are presented here in the form of a review, incorporating new evidence from the author's own research.

The spatial distribution of recorded finds of reindeer remains from Scotland

The literature survey revealed that reindeer remains have been recorded from at least 18 Scottish sites: two separate sites on Rousay (in the Orkneys), in brochs at Keiss and Yarhouse (Caithness), in the Creag nan Uamh caves and in the Cill-Trolla broch (Sutherland), at Tain (Ross & Cromarty), Marlee (Fife), Croftamie (Dumbartonshire), Jordanhill, Queen's Park and Raesgill (Lanarkshire), Kilmaurs and Tarbolton (Ayrshire), Craighton (West Lothian), Green Craig (Mid-Lothian), Middlestots (Berwickshire) and at Shaw (Dumfriesshire) (Scouler 1852; Smith 1857, 1869, 1879; Young & Craig 1869; Munro 1879; Anderson 1883; Henderson 1886; Simpson 1886; Richardson 1886; Gregory & Currie 1928; Reynolds 1931; Platt 1936; Macgregor & Ritchie 1940). The distribution of these sites is shown in Fig. 1. Reynolds (1931) also lists reindeer remains from Essendene near Kilmarnock and from Selkirk, but as no source references are given, and as these sites are not referred to elsewhere, they have been omitted from Fig. 1. Claims by Reynolds that reindeer remains were found at Kirkconnel (Dumfriesshire), and by Delair (1969) that they were also discovered in MacArthur Cave near Oban, are not substantiated by faunal lists in the original references (McAdam 1886; Anderson 1895; Turner 1895).

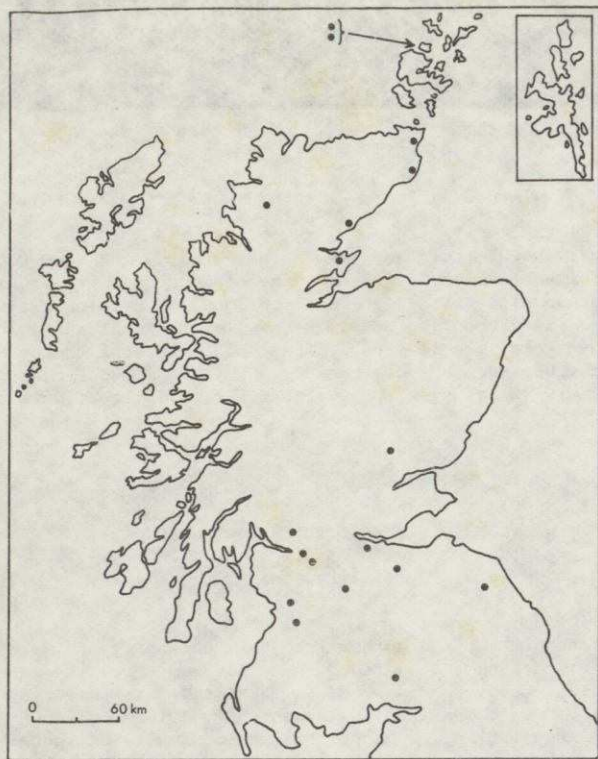


Fig.1. Scottish sites where reindeer remains have been recorded.

As can be seen from Fig. 1, reindeer remains have a fairly wide distribution over much of Scotland, excluding the main highland areas. With respect to reindeer remains of Lateglacial age or older, this partly reflects the distribution of Loch Lomond Advance glaciers and the associated disruption and destruction of suitable sites for their preservation. However, in terms of the distribution pattern as a whole, it must reflect the degree to which areas have been studied or excavated by man. It is very possible that areas of Scotland at present devoid of finds may yield reindeer remains in the future.

Temporal distribution of reindeer remains in Scotland

The majority of the discoveries of reindeer remains in Scotland were made in the last century. In order to ascertain the temporal distribution of these finds one must, therefore, rely on mostly inadequate, undetailed excavation reports relating to stratigraphies that have long been destroyed. Only one radiocarbon date from a sample of reindeer bone or antler has been published - that of > 40,000 years B.P. (Birm-93) obtained from a piece of reindeer antler from Kilmaurs (Shotton *et al.* 1970). The author recently submitted to the N.E.R.C. Radiocarbon Laboratory at East Kilbride several samples of reindeer antler fragments or bone from two stratigraphic positions in Reindeer Cave on

the Creag nan Uamh, Assynt, Sutherland. A bulked sample of antler fragments (SRR-1788) from a layer of frost-shattered debris from the entrance chamber of the cave gave a date of $10,080 \pm 70$ years B.P. Another bulked sample of antler fragments (SRR-1789) came from the top of silty-sand deposits that almost filled an inner chamber of the cave to its roof; this sample yielded a date of $18,040 \pm 240$ years B.P. As the latter date had important implications as to the timing of the last glaciation of the Assynt area, three further samples from the same stratigraphic position as sample SRR-1789 (this time of individual antler pieces and a single leg bone of a juvenile reindeer) were submitted for dating. These samples gave dates of $25,360^{+810}_{-740}$ years B.P. (SRR-2103), $24,590^{+790}_{-720}$ years B.P. (SRR-2104) and $8,300 \pm 90$ years B.P. (SRR-2105).

The range of dates obtained from the inner chamber of the cave is interesting but not problematic. Entry to the inner chamber is difficult at the present time (Lawson 1981, 1983), and would have been more so after the deposition in the entrance chamber of the Lateglacial and Postglacial sediments that have now been excavated. Reindeer remains in the inner chamber are, therefore, considered to have been deposited there by smaller carnivores such as the northern lynx and wolf, whose remains were also found in the cave. The range of radiocarbon dates obtained therefore present no problem as it is likely that the reindeer material was derived from elsewhere in the area. However, the bulked sample which gave a date of $18,040 \pm 240$ years B.P. (SRR-1789) is now considered to be unreliable, being an 'average' date from a mixture of material of widely differing ages.

Evidence pertaining to times before the existence of the last (Late Devensian) ice-sheet in Scotland is very sparse (Sissons 1976, 1981), and hence it is not surprising that there is at present no unequivocal evidence for the existence of reindeer in Scotland prior to the Devensian period. Certain of the reindeer remains appear to pre-date the Late Devensian ice-sheet: the antler fragments at Kilmaurs were found in clays overlain by till; reindeer bones and an antler fragment from Queen's Park in Glasgow were found in gravel beneath till; the portion of reindeer antler found at Raesgill near Carlisle was discovered in sediments described as 'boulder clay' (Smith 1869), and therefore is contemporary with or pre-dates the last ice-sheet in the area; some of the reindeer material from the Creag nan Uamh appears to date from an early phase of the Late Devensian ice-sheet in view of the dates obtained from samples SRR-2103 and SRR-2104.

Reindeer were evidently present in Scotland in the Lateglacial period, as testified by the find at Croftamie, where a large piece of antler was discovered in blue marine clay overlain by till deposited by ice that had issued from the valley presently containing Loch Lomond during the Loch Lomond Stadial (Smith 1857). The presence of reindeer remains in a layer of frost-shattered dolomite debris, attributed to this stadial (Lawson 1983), in the entrance chamber of Reindeer Cave on the Creag nan Uamh, supports this view; this material was dated by radiocarbon to $10,080 \pm 70$ years B.P.

In view of Scotland's geographical location, it is likely to have been a refuge area for 'arctic' species, such as the reindeer, at the end of the Devensian and into the Flandrian. The stratigraphic location of some of the Scottish reindeer finds shows this to be the case. Both the antlers found on Rousay were discovered in peat, as were the reindeer remains from Shaw and Middlestots. The radiocarbon date of $8,300 \pm 90$ years B.P. from the Creag nan Uamh underlines the fact that reindeer survived in Scotland at least into the early part of the Flandrian. Certain occurrences of reindeer remains associated with the presence of man are more enigmatic (discussed below): those at Keiss, Yarhouse and Cill-Trolla were associated with brochs, those at Tarbolton with a crannog, and those at Tain with some hut circles.

Discussion

Although none of the Scottish finds indicate that reindeer existed in Scotland prior to the Devensian period, it is likely that they did so. Stuart (1982) lists examples of reindeer remains from elsewhere in the British Isles from contexts as old as the Anglian period. He has pointed out that they are generally restricted to cold stages rather than interglacial periods, and usually associated with treeless steppe-tundra vegetation. Reindeer can survive in even the harshest conditions as long as there are at least some lichen-covered rocks off which to graze.

Sissons (1981) has quite rightly pointed out the weakness of the arguments for ice-free conditions in Scotland in the period c. 30,000-25,000 years B.P., prior to the last advance of the Late Devensian ice-sheet. Such arguments were based on only four radiocarbon dates, the reliability of which can be seriously doubted. The significance of the dates of $25,360 \pm 810$ and $24,590 \pm 790$ years B.P. - 740 - 720

from the Creag nan Uamh caves becomes clear when one appreciates that the presence of reindeer remains indicates that, at the time the animals were alive, at least part of the local area was free of glacier ice. The location of the cave entrances requires any ice surface to be below 330 m O.D. at this time, and although the above radiocarbon dates do not on their own preclude the existence of glacier ice in the Assynt area, evidence from dated speleothems (the author, unpublished data) suggests that any such ice would have been very restricted in extent.

The degree to which reindeer survived into the Postglacial period in Scotland has long been a point of contention. Hibbert (1831) argued that the presence of reindeer remains from the northern Scottish brochs supported claims by Torfaeus, writing at the close of the 17th century, that literary evidence suggests reindeer were still being hunted in Scotland in 1159 A.D. Gregory & Currie (1928) were unconvinced as to the authenticity of the fragmentary osseous material and pointed out that there is no direct evidence that the antler fragments represent reindeer contemporaneous with the human occupation of the brochs. From evidence discussed above, it cannot be doubted that reindeer existed into at least the early part of the Flandrian period in Scotland. The author can see no reason why reindeer should not have survived much later, as suggested by the evidence from the brochs (which date from around the beginning of the present millennium); after all, reindeer

have been thriving in the Cairngorms area since their reintroduction in 1952. The reason for their disappearance from Britain may well have been due to man's hunting activities rather than the spread of boreal forest associated with climatic amelioration (favoured by Stuart (1982)).

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References

- Anderson, J. (1883) *Scotland in Pagan Times. Iron Age.*
- Anderson, J. (1895) Notice of a cave recently discovered at Oban, containing human remains, and a refuse-heap of shells and bones of animals, and stone and bone implements. *Proc. Soc. Antiq. Scot.* 29, 211-230.
- Callender, J.G., Cree, J.E. & Ritchie, J. (1927) Preliminary report on caves containing Palaeolithic relics, near Inchnadamph. *Proc. Soc. Antiq. Scot.* 61, 169-172.
- Delair, J.B. (1969) North of the hippopotamus belt: a brief review of Scottish fossil mammals. *Mammal Soc. Bull.* 31, 16-21.
- Gregory, J.W. & Currie, E.D. (1928) The vertebrate fossils from the Glacial and associated Post-Glacial beds of Scotland in the Hunterian Museum, Glasgow University. *Monogr. no.2, Geol. Dept., Hunterian Mus.*
- Henderson, J. (1886) On reindeer and other mammalian remains from the Pentland Hills. *Trans. Edinb. Geol. Soc.* 5, 302-304.
- Hibbert, S. (1831) On the question of the existence of the reindeer in the twelfth century in Caithness. *Edinb. J. Sci.* n.s. 5, 50-52.
- Lawson, T.J. (1981) The 1926-7 excavations of the Creag nan Uamh bone caves, near Inchnadamph, Sutherland. *Proc. Soc. Antiq. Scot.* 111, 7-20.
- Lawson, T.J. (1983) *Quaternary geomorphology of the Assynt area, N.W. Scotland* (unpubl. Ph.D. thesis, Univ. of Edinburgh).

- Macgregor, M. & Ritchie, J. (1940) Early glacial remains of reindeer from the Glasgow district. *Proc. R. Soc. Edinb.* 60, 322-332.
- McAdam, W.I. (1886) Exhibition of, and notes on, specimens of red-deer horn from the sand deposits at the mouth of the Nith, Dumfriesshire. *Trans. Geol. Soc. Edinb.* 5, p. 305.
- Munro, R. (1879) Notice of the excavation of a crannog at Lochlee, Tarbolton, Ayrshire. *Proc. Soc. Antiq. Scot.* 13, 175-252.
- Peach, B.N. & Horne, J. (1892) On a bone cave in the Cambrian limestone in Assynt, Sutherlandshire. *Rpt. Brit. Ass.* 1892, p.720.
- Peach, B.N. & Horne, J. (1917) The bone-cave in the valley of Allt nan Uamh (Burn of the Caves), near Inchmadamff, Sutherlandshire. *Proc. R. Soc. Edinb.* 38, 327-343.
- Platt, M.I. (1936) Reindeer antlers from Rousay, Orkney. *Proc. Soc. Antiq. Scot.* 70, 435-441.
- Reynolds, S.H. (1931) British Pleistocene Mammalia. *Palaeontographical Soc. Monogr.* 3, pt. 4, p.27.
- Richardson, R. (1886) On the antiquity of man, and the discovery of fossil Mammalia in Devonshire and Scotland. *Trans. Edinb. Geol. Soc.* 5, 335-349.
- Scouler, J. (1852) Of the occurrence of the remains of the reindeer in Scotland. *Edinb. New Philos. Journ.* 52, 135-137.
- Shotton, F.W., Blundell, P.J. & Williams, R.E.G. (1970) Birmingham University radiocarbon dates. IV. *Radiocarbon* 12, 385-389.
- Simpson, J. (1886) On reindeer and other mammalian bones discovered by Mr. Macfie of Dreghorn in a rock-fissure at Green Craig, Pentland Hills. *Trans. Edinb. Geol. Soc.* 5, 294-301.
- Sissons, J.B. (1976) *Scotland*, Methuen, London.
- Sissons, J.B. (1981) The last Scottish ice-sheet: facts and speculative discussion. *Boreas* 10, 1-17.
- Smith, J.A. (1857) Notice of the horn of a reindeer (*Cervus tarandus* Linn.) found in Dumbartonshire. *Edinb. New Philos. Journ.* n.s. 6, 165-167.
- Smith, J.A. (1869) Notice of the remains of the reindeer, *Cervus tarandus*, found in Ross-shire, Sutherland and Caithness; with notes of its occurrence throughout Scotland. *Proc. Soc. Antiq. Scot.* 8, 186-222.
- Smith, J.A. (1879) Notice of a skull of a large bear (*Ursus arctos* Linn.) found in a moss in Dumfriesshire. With remarks on recorded references to the presence of the bear in former times in Scotland. *Proc. Soc. Antiq. Scot.* 13, 360-367.
- Stuart, A.J. (1982) *Pleistocene Vertebrates in the British Isles* Longmans, London.

- Turner, W. (1895) On human and animal remains found in caves at Oban, Argyllshire. *Proc. Soc. Antiq. Scot.* 29, 410-438.
- Young, J. (1876) On a specimen of the lower portion of the horn of the reindeer (*Cervus tarandus*), now extinct in the British Isles. *Nat. Hist. Soc. Glasg.* 2, p.5.
- Young, J. & Craig, R. (1869) Notes on the occurrence of seeds of freshwater plants and arctic shells, along with the remains of the mammoth and reindeer, in beds under the boulder clay at Kilmaurs. *Trans. Geol. Soc. Glasg.* 3, 310-321.

WAVE RIPPLE-MARKS IN GLACIOLACUSTRINE CLAYS AT CHELFORD, CHESHIRE.

By T.R. Good

Introduction

Symmetrical wave ripple-marks have been widely noted in modern fluvial, lacustrine and marine sediments, and studies of the inter-relationships between ripple morphology, grain size, and the dynamics of water motion enable greatly improved interpretations of ancient ripple marks to be made (J.R.L. Allen, 1979, 1982). This report discusses the environmental significance of thin wave rippled sand units in a glacial lacustrine laminated clay bed deposited during the Devensian Glaciation of north-west England.

The sediments deposited during the Devensian Glaciation of the Cheshire Plain often show rapid vertical and lateral facies changes. The wave-rippled bed described here was exposed near Chelford (fig.1) 25km south of Manchester, and forms part of a variable succession of lacustrine clays, tills, sands and gravels assigned to the Stockport Formation (Worsley 1967). Elsewhere on the Cheshire Plain, however, for example in the Bent Farm sand quarry near Congleton (G.R. SJ 830623), the Stockport Formation comprises a single cohesive lodgement till with a rich assemblage of northern erratics.

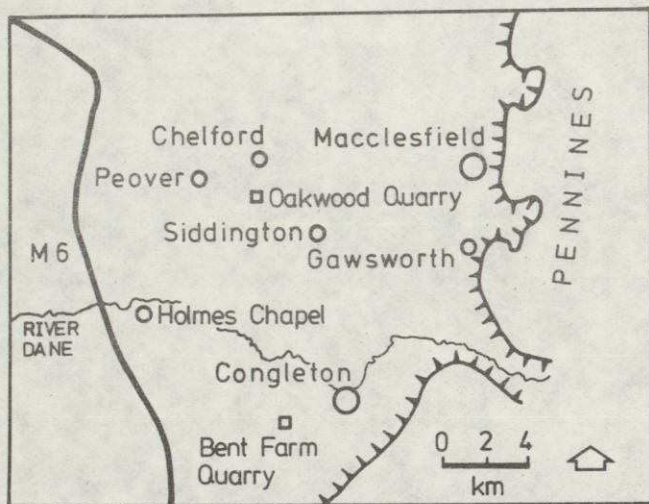


Fig.1 Location map of sites mentioned in text.

Early workers also noted the variable nature of the tills around Macclesfield and Congleton (Hull & Green 1866). Stone free laminated clays of glaciolacustrine origin, locally containing sand layers, were described by Pocock (1906) around Macclesfield and to the east of Chelford between Siddington and Gawsorth, and extending westwards to Peover. More recently Evans *et al* (1968) have recorded laminated clays from several sites around Chelford, with a thickness of up to 6m being recorded along the M6 Motorway near Holmes Chapel. The formation of several restricted lakes during the deglaciation of the western flanks of the Pennines is postulated by Jowett and Charlesworth (1929, plate 19) to explain some of these sediments and the 305 ft. stage of Lake Lapworth, according to Poole and Whiteman (1961), extended over the Chelford site. However, the nature of the glaciogenic sediments in the surrounding area supports the view of Evans *et al* (1968) that there is little evidence for high lake levels.

The characteristics of the ripples described in the following section enable the size, depth and sedimentary processes of the water body in which they were deposited to be estimated.

Description

A prominent clay bed with uniform thickness of 2m visible along 400m of lateral exposure forms part of a succession of glaciogenic sediments up to 7m thick exposed in the Oakwood Quarry (G.R. SJ 821722) near Chelford. The clay bed rests on cross-laminated muddy sands reworked from the underlying Chelford Sand Formation and is overlain by interbedded sands, gravels and thin clay units of fluvioglacial origin. The upper and lower contacts of the clay bed are sharp and undisturbed although locally load casting from the overlying sands has occurred. At intervals of 0.06m - 0.35m horizontal discontinuities occur within the bed (fig.2). These are commonly marked by thin sandy partings, isolated sand lenses, or regularly spaced symmetrical ripple-marks varying in thickness from a few grains to a maximum of 10mm. Between discontinuities the clay units which comprise the rest of the bed have a soft plastic, stone free texture, and are structureless or contain very thin (<0.5mm) to medium (<5mm) laminations. Laminations are sharply defined and consist of relatively pale silt or dark coal fragments. Most of the bed consists of dark red-brown clays (5YR 4/4), closely resembling the local Triassic Mercia Mudstone, with coal fragments probably derived from the Upper Carboniferous Coal Measures exposed 30km to the north. Some laminations have an uneven wavy form and are truncated by small shallow scours (<1cm deep) or show cross-lamination.

The sandy discontinuities within the bed form horizontal planes of weakness which facilitate parting of depositional surfaces within large collapsed blocks. Although the ripples have well defined crests, they lack the trochoidal form commonly found in modern ripples, having instead a flatter and in some cases gently curved convex up profile (fig.3). In planform the ripple crests are straight or slightly sinuous with "tuning fork" bifurcations between adjacent crests. Beneath the ripples there is a flat erosive surface with a sharp contact between the underlying muddy substrate and the fine well sorted sand with a mean grain size (D) of 0.02cm. Coal fragments up to 2.6cm occur in some ripple troughs. Some ripples are draped by up to 0.5cm of thinly laminated silts which have a sharp but uneven contact with the darker

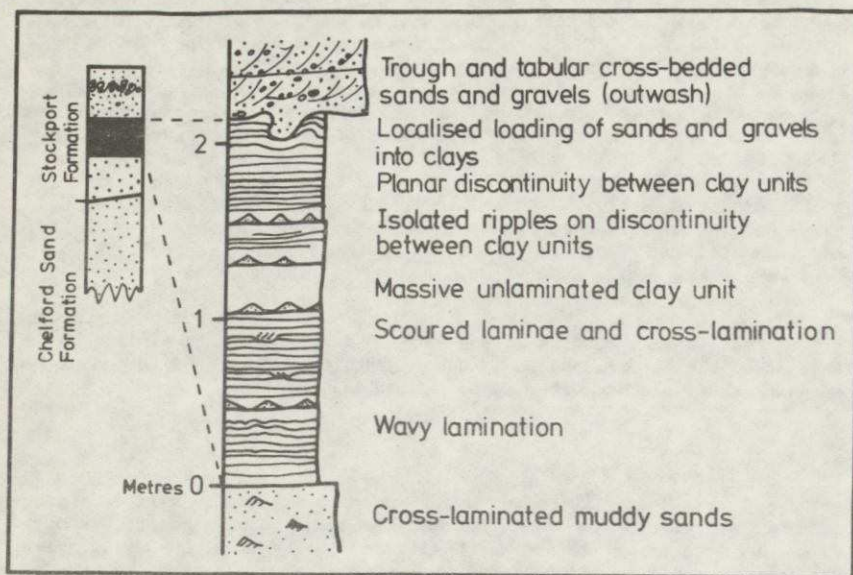


Fig.2 Sedimentary log through wave rippled and laminated clays at Oakwood Quarry, Chelford.

overlying red-brown clays. Small flame-like intrusions of the pale silts into the overlying clays occur along this contact. The average wavelength (λ) of 4.7cm and height (η) 0.7cm of ripples gives them a vertical form index (vfi) of 6.75 (length/height). Vertical form indices provide a convenient measure of ripple morphology, although they have the disadvantage of increasing as sediment is compacted and in isolated ripples such as these, where a starved sediment supply (rather than current conditions) may have limited the height of ripple growth. The vfi of 6.75 found here is probably higher (i.e. the ripples are flatter) than if they were fully developed. Nevertheless, the vfi lies within the common range for wave ripples of 6 to 7 given by Reineck and Singh (1975) and little evidence of compaction of the ripples is apparent.

Ripple-Mark Interpretation

The straight parallel crests, crest symmetry and relatively short wavelength ($\lambda=4.5\text{cm}$) distinguishes these ripples as wave or wave-current forms (Reineck and Singh 1975, J.R.L. Allen 1982) which formed on a muddy substrate starved of sand.

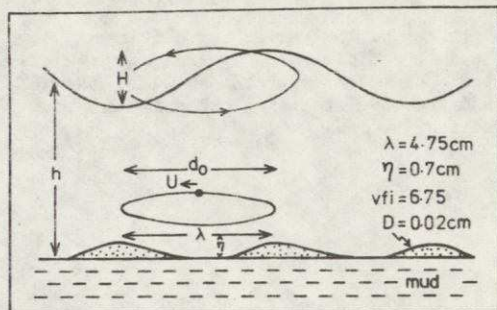


Fig.3 Profiles of Chelford wave ripples showing schematically height of waves (H), depth of water (h), and orbital diameter (d_o) and velocity (U) of near-bed water particles. Values of ripple wavelength (λ) and amplitude (η) as given in text.

In general the morphology and wavelength of ripples is related to the characteristics of water motion under progressive waves and the grain size of the bed material. The orbital motion of water particles induced by the passage of waves becomes flattened towards the bed (fig.3) and for small period waves the relationship $\lambda = 6.5d_o$ is found where d_o is the maximum diameter of near-bed water particle motion (Miller and Komar 1980). These characteristics become largely independent however as orbital diameter increases, but at coarse grain sizes ripple wavelength increases with grain size (Clifton 1976). Changes in ripple morphology also occur with wavelength (Bagnold 1946) and have been plotted by J.R.L. Allen (1979, fig.2) as vertical form index in terms of ripple wavelength and orbital diameter.

It is possible to interpret wave ripples in terms of the wave period (T), wave height (H) and water depth (h) in which they formed by using the empirically established ripple existence fields expressed graphically by Komar (1974) and J.R.L. Allen (1979) and used for example by Sundquist (1982), or Komar's computer program as used in a slightly modified form here and by P.A. Allen (1981). This latter method does not require the use of vertical form indices and thus avoids the attendant problems of compaction and isolated ripples. Sundquist's analysis of flat topped ripples necessitated reconstruction of the idealised trochoidal form of many modern ripples, in order to estimate vfi 's.

The method used here requires details of ripple wavelength, grain size and grain density. Since the near-bed water particles undergo simple harmonic motion the wave period can be found from the expression

$T = \pi d_o / U_{\max}$ where U_{\max} is the maximum near-bed current velocity. The program first calculates d_o from $\lambda = 0.65 d_o$ which Miller and Komar (1980) have recently suggested is a more precise relationship than $\lambda = 0.8 d_o$ used in the original program. Thereafter for different values of T possible values of H and h that would produce d_o are computed between the limits defined by the sediment entrainment threshold (U_t), defined by Komar and Miller (1973), and the wave stability criteria of Iverson (1951) and Miche (1944) (see fig.4).

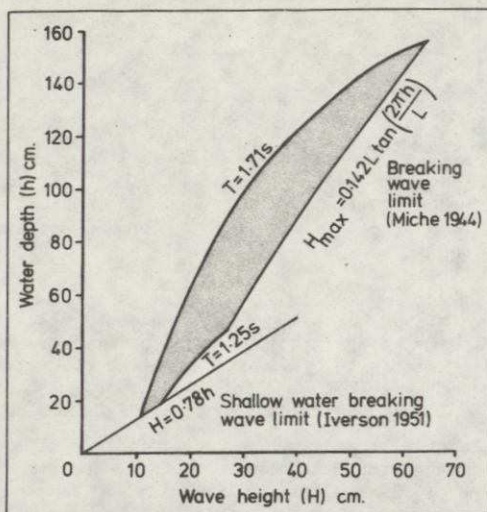


Fig.4 Wave ripple stability field (computed using method of Komar 1974).

The computed results giving the range of water depths and wave heights under which the ripples of this example could form are shown in figure 4. The maximum wave period under which ripples could form is 1.71s, below which the threshold current velocity (U_t) of 0.13 ms^{-1} would not be exceeded. Such waves might occur in water up to 1.55m deep and would break above a maximum height of 0.65m. The maximum wave period that can be generated in a given water body is controlled by the available fetch. Wave periods of less than approximately 4s are indicative of limited fetch and shallow water as found for example in lakes, bays or lagoons, whereas values greater than 10s are only found in open shelf seas (Komar 1974). The values found here are therefore consistent with those which are characteristic of a small shallow lake.

Discussion

The wave rippled sand units throughout the bed, and the estimates of wave conditions under which they formed, represent the most vigorous periods of water motion, and probably occurred as just brief departures from normal conditions of mud sedimentation. The effect of an unsteady oscillatory current, increasing to a maximum velocity of 0.18 ms^{-1} , on the entrainment or deposition of a mud bed is difficult to determine. As Banner (1979) and J.R.L. Allen (1982) have noted, the many complex variables to be considered include the degree of consolidation, grain size, mineralogy and organic content of the sediment, and temperature and electrolytic composition of the water. Compared to sand beds, therefore, relatively little is known about the entrainment and deposition conditions of muds.

In deep glacial lakes, waves are commonly too small to entrain large amounts of bottom sediment, and even in shallow lakes this is probably an insignificant process compared to the delivery of large volumes of suspended sediment from rivers and direct from glaciers. Suspended sediment concentrations in glacial lakes often exceed the minimum required to form interbedded sands and muds in flume experiments (Hawley 1981). In Lillooet Lake, British Columbia, for example, underflows from the Lillooet River with concentrations of 1500 mg/l have been measured (Gilbert, 1975) and in Malaspina Lake, Alaska, concentrations of 700 mg/l (Gustavson, 1975). Although in deeper lakes density underflows have been widely recorded (Gustavson 1975; Gilbert 1975, Smith 1982) and shown to produce turbidites (Harrison 1975, and others) in this shallow example they would not be expected. The generation of laminated glaciolacustrine sediments has been described in shallow water (2-3m) by Theakstone (1976) and attributed to pulsatory sediment supply and sorting during sedimentation. The truncated laminae, small scours and indistinct cross-lamination described here might result from sluggish underflows, or weak oscillatory flows also in shallow water.

The foregoing discussion enables a more precise model to be formulated of how the lenticular bedded sand-mud succession was deposited. During conditions of normal sedimentation settling of the suspended load would produce laminated clays and silts with gradual deformation during compaction producing wavy lamination. During disturbance of the bed by current activity particulate resuspension of the uppermost unconsolidated muds would occur under low shear velocities. The problems of determining the critical shear velocities for freshly deposited muds are fully discussed by Terwindt and Breusers (1972, 1982) and Hawley (1981), however the entrainment thresholds of particles under unidirectional currents may differ considerably from the oscillatory flows of this example (Komar and Miller 1973, Hammond and Collins 1979). Further increase in velocity will cause mass erosion of the bed until equilibrium is reached between the maximum current velocity and consolidated muds exposed at a depth of a few cm. At this stage if the entrainment velocity of sand has been exceeded and a suitable supply exists then transport over the stable muddy substrate will occur. During waning flow sand transport will cease, and after further fall of current velocity mud sedimentation recommences, first in ripple troughs and later over ripple crests. Since mud entrainment is retarded by cohesive forces, sedimentation recommences at a slightly lower velocity than entrainment. In this manner sharp planar based ripples are formed consisting of clean well washed sand and

showing no evidence of grading. If maximum current velocities do not exceed U_c for sand or the substrate is starved of sand then an erosive discontinuity will form within the bed.

Regular disturbance of a small lake by wind generated waves is indicated by these results with only a small input of sand and coarser sediment suggesting that the ripples formed in a relatively distal part of the lake basin away from the major sediment sources. There is no evidence for material derived from floating ice.

Conclusions

Examination of rippled sand units in a laminated clay bed from Cheshire shows that

1. Part of the 'Stockport Formation' has been deposited in standing water bodies as a glaciolacustrine clay, and this facies shows no evidence of direct contact with ice.
2. Sedimentation of laminated clays and silts from a high suspension load has been disrupted at regular intervals by wave action. This has produced stratification with lenticular bedding or erosive discontinuities at intervals through the bed.
3. The lenticular beds consist of wave ripples generated under wave periods of less than 1.71 sec in a small lake and in water which did not exceed about 1.5m depth.

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References

- Allen, J.R.L. 1979. A model for the interpretation of wave ripple-marks using their wavelength, textural composition, and shape. *Jl. Geol. Soc. London*, Vol. 136, pp.673-682.
- Allen, J.R.L. 1982. Sedimentary Structures: their character and physical basis. *Developments in Sedimentology* 30A. Elsevier, Amsterdam. 593 pp.
- Allen, P.A. 1981. Wave generated structures in the Devonian lacustrine sediments of south-east Shetland and ancient wave conditions. *Sedimentology*, 28, pp.369-379.

- Bagnold, R.A. 1946. Motion of waves in shallow water. Interactions between waves and sand bottoms. *Proc. R. Soc. London*, A 187, pp. 1-15.
- Banner, F.T. 1979. Sediments of the North-Western European Shelf. In: Banner, F.T., Collins, M.B., Massie, K.S. (eds.), *The North West European Shelf Seas: the sea bed in motion. Vol. 1. Geology and Sedimentology, Elsevier Oceanography Series 24A*. pp. 271-300.
- Clifton, H.E. 1976. Wave-formed sedimentary structures - a conceptual model. In: R.A. Davis and R.L. Ethington (Editors), *Beach and Nearshore Sedimentation. Spec. Publ. Soc. Econ. Paleont. Miner.*, 24, pp.126-148.
- Evans, W.B., Wilson, A.A., Taylor, B.J., Price, D. 1968. Geology of the country around Macclesfield, Congleton, Crewe and Middlewich. *Mem. Geol. Surv.* 110, 328 pp.
- Gilbert, R. 1975. Sedimentation in Lillooet Lake, British Columbia, *Canadian Journal of Earth Sciences*, 12, pp.1697-1711.
- Gustavson, T.C. 1975. Sedimentation and physical limnology in proglacial Malaspina Lake, south-eastern Alaska. In: Jopling, A.V. and McDonald, B.C. (eds.), *Glaciofluvial and Glaciolacustrine sedimentation. Spec. Publ. Soc. Econ. Paleont. Miner.*, 23, pp.249-263. Tulsa.
- Hammond, T.M. and Collins, M.B. 1979. On the threshold of transport of sand-sized sediment under the combined influence of unidirectional and oscillatory flow. *Sedimentology*, 26, pp. 795-812.
- Harrison, S.S. 1975. Turbidite origin of glaciolacustrine sediments, Woodcock Lane, Pennsylvania. *Jl. Sediment Petrol.*, 45, pp. 738-744.
- Hawley, J. 1981. Flume experiments on the origin of flaser bedding. *Sedimentology*, 28, pp.699-712.
- Hull, E. and Green, A.H. 1866. The geology of the country round Stockport, Macclesfield, Congleton and Leek. *Mem. Geol. Surv.* 81, 102 pp.
- Iverson, H.W. 1951. Studies of wave transformation in shoaling water, including breaking. *Natl. Bur. Standards Circ.*, 521, pp. 9-32.
- Jowett, A. and Charlesworth, J.K. 1929. The glacial geology of the Derbyshire dome and the western slopes of the southern Pennines. *Q. Jl. Geol. Soc. London*, 85, pp.307-334.
- Komar, P.D. 1974. Oscillatory ripple marks and the evaluation of ancient wave conditions and environments. *Jl. Sediment. Petrol.*, 44, pp. 169-180.
- Komar, P.D. and Miller, M.C. 1973. The threshold of sediment movement under oscillatory water waves. *Jl. Sediment. Petrol.*, 43, pp. 1101-1110.

- Miche, R. 1944. Undulatory movements of the sea in constant and decreasing depth. *Annls Ponts Chauss.* May-June, July-August, 25-78, 131-164, 270-292, 369-406.
- Miller, M.C. and Komar, P.D. 1980. Oscillation sand ripples generated by laboratory apparatus. *Jl. Sediment. Petrol.*, 50, pp. 173-182.
- Pocock, T.I. 1906. The geology of the country around Macclesfield, Congleton, Crewe and Middlewich. *Mem. Geol. Surv.* 110, 138 pp.
- Poole, E.G. and Whiteman, A.J. 1961. The glacial drifts of the southern part of the Shropshire-Cheshire Basin. *Q. Jl. Geol. Soc. London*, 117, pp.91-130.
- Reineck, H.E. and Singh, I.B. 1975. *Depositional Sedimentary Environments*. Springer-Verlag, Heidelberg. 439 pp.
- Smith, N.D., Verol, M.A. and Kennedy, S.K. 1982. Comparison of sedimentation in four glacier-fed lakes of western Alberta. In: Davidson-Arnott, Nickling, W., Fahey, B.D. (eds.). *Research in Glacial, Glaciofluvial and Glaciolacustrine Systems. Proc. 6th Guelph Symp. on Geomorph.* pp. 203-238.
- Sundquist, B. 1982. Palaeobathymetric interpretation of wave ripple-marks in a Ludlovian grainstone of Gotland. *Geol. Foren. Stockh. Forh.*, 104, pp. 157-166.
- Terwindt, J.H.J. and Breusers, H.N.C. 1972. Experiments on the origin of flaser lenticular and sand-clay alternating bedding. *Sedimentology*, 19, pp. 85-98.
- Terwindt, J.H.J. and Breusers, H.N.C. 1982. Discussion: Flume experiments on the origin of flaser bedding. *Sedimentology*, 29, pp. 903-907.
- Theakstone, W.H. 1976. Glacial lake sedimentation Austerdalsisen, Norway. *Sedimentology*, 23, pp.671-688.
- Worsley, P. 1967. Problems in naming the Pleistocene deposits of the north-east Cheshire Plain. *Mercian Geologist*, 2, pp. 51-55.

A P-FORM SITE ON THE ISLE OF ISLAY, SCOTTISH INNER HEBRIDES

By J.M. Gray

The author recently described the extensive development of p-forms that occurs along the southern shore of Loch na Keal on the Isle of Mull (Gray, 1981). At that time it was the only site in Britain where large numbers of p-forms had been described, but the author suggested (p. 40) that "it seems unlikely that this is the only British locality where numbers of p-forms exist".

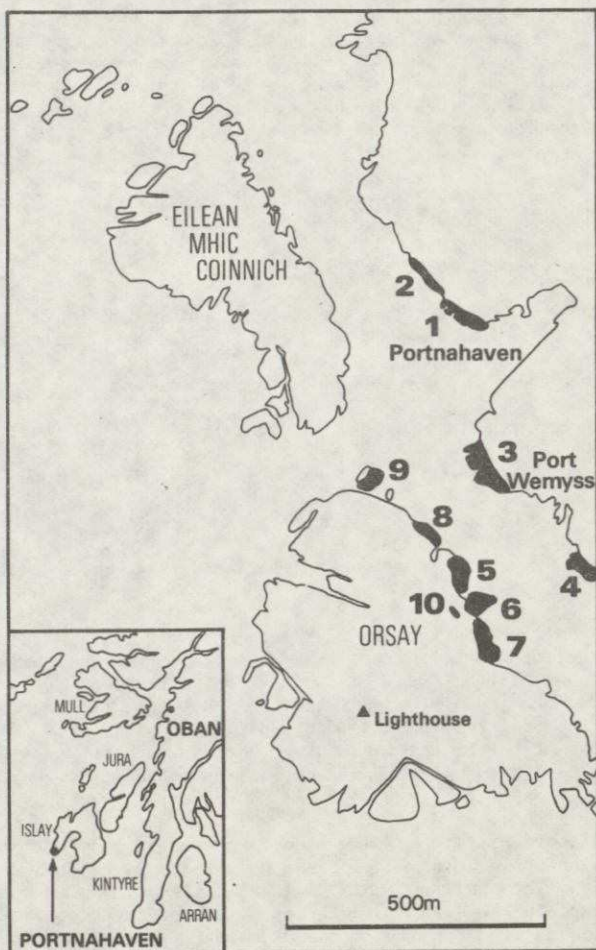


Figure 1 The p-form site at Portnahaven and localities (shaded and numbered) where p-forms have been discovered.

Following publication, Dr. R. Anderton, University of Strathclyde notified the author of a p-form locality at Portnahaven on the Isle of Islay. The locality discovered by him is marked 1 on Fig. 1 and subsequent mapping revealed a number of other outcrops around Portnahaven and on the north coast of Orsay Island on which p-forms occur. As on Mull they are best developed on abraded bedrock in the intertidal zone where they have been neither significantly weathered nor masked by vegetation. The rock type in the area is Lewisian gneiss with marked banding striking approximately southwest-northeast. This is at right angles to former ice movement in the area, as revealed by striae and other indicators, which was from southeast to northwest.

The development of p-forms is not as extensive or impressive as on Mull but several well-formed individual features occur, particularly at sites 1, 2, 5 and 8. As on Mull the most common p-form types are curved or winding channels, but some bowls also occur. At site 10 there is a possible cavetto (Dahl, 1965), and at site 8 some possible mussel gouges are present (Bernard, 1971).

The channels display most of the characteristics of those from Mull including that they:-

- i) often have striated floors and walls
- ii) are in general orientated in the dominant direction of ice flow (mean of 14 channels = 321° , mean of 5 striae measurements = 318°)
- iii) are developed largely independently of jointing
- iv) may be one-sided or markedly asymmetric
- v) frequently have sharp upper edges and/or undercut sides
- vi) often have overdeepened floor sections
- vii) may show small scale meanders (radii sometimes under 10cm)

The major difference at Portnahaven involves the more heterogeneous nature of the Lewisian Gneiss compared to the Tertiary basalt on Mull. At some of the Portnahaven sites (eg. site 6) the variable resistance to erosion of the gneissic bands has resulted in channels that are extremely irregular in both long profile and width (Fig. 2). A further point of particular interest at Portnahaven occurs at site 8 where there is a dense network of very narrow channels, c.10-20cm wide.

The above differences are minor, however, and do not invalidate the conclusions on origin made for the Mull features. Table 1 is an attempt to show how well the three major theories suggested for p-form formation explain the main characteristics of the features listed above. Glacial abrasion (Boulton, 1974) can explain the striated floors and sides of the channels, but has difficulty in explaining the sharp edges and undercuts. Till squeezing (Gjessing, 1965) is something of an unknown quantity but appears unlikely to produce some characteristics, e.g. channel asymmetry. Erosion by meltwater flow (Dahl, 1965) is capable of explaining most of the characteristics, particularly the



Figure 2 Irregular channels at site 6 developed perpendicular to banding in the gneiss. Ice movement was from top left to lower right.

sharp edges, facets and undercut walls, but cannot account for the regularity of striae on the floors and walls of the channels.

Table 1 Suggested qualitative assessment of the ability of the three major theories in explaining p-form characteristics.

Channel characteristics	Glacial abrasion	Till squeezing	Meltwater erosion
Striated floors and walls	++	?	-
Orientated with ice flow	++	+	+
Independent of jointing	+	+	+
Asymmetry	-	-	+
Sharp edges and undercuts	-	?	++
Overdeepened floors	+	+	++
Small scale meanders	-	?	++

++ = very good

+ = good

? = uncertain

- = weak

Since none of the three theories seems capable of accounting for all the characteristics of the p-forms on Mull and Islay, it is suggested that a two phase origin is most likely, viz. erosion by corrasion and cavitation associated with high subglacial meltwater discharges, followed by a phase of glacial abrasion during which the striae were produced.

With the discovery of this p-form assemblage on Islay, together with individual features found at various localities in Snowdonia (Gray, 1982; Gray and Lowe, 1982), it appears even more likely that numerous similar p-form sites occur in Britain.

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References

- Bernard, C. 1971. Les marques sous-glaciaires d'aspect plastique sur la roche en place (p-forms): observation sur la bordure du bouchier Canadien et examen de la question (1). *Rev. Geogr. Montr.* 25, 111-27.
- Boulton, G.S. 1974. Processes and patterns of glacial erosion. In Coates, D.R. (ed) *Glacial geomorphology* State Univ. of New York, 41-87, Binghamton.
- Dahl, R. 1965. Plastically sculptured detail forms on rock surfaces in northern Nordland, Norway. *Geogr. Annlr.* 47, 83-140.
- Gjessing, J. 1965. On plastic scouring and subglacial erosion. *Norsk. geogr. Tidsskr.* 20, 1-37.
- Gray, J.M. 1981. p-forms from the Isle of Mull. *Scott. J. Geol.* 17, 39-47.
- Gray, J.M. 1982. Unweathered, glaciated bedrock on an exposed lake bed in Wales. *J. Glaciol.* 28(100), 483-97.
- Gray, J.M. and Lowe, J.J., 1982. Problems in the interpretation of small-scale erosional forms on glaciated bedrock surfaces: examples from Snowdonia, North Wales. *Proc. Geol. Assoc. London* 93, 403-14.

RED SOILS AND GLACIAL EROSION IN BRITAIN

By John Boardman

Lawson's (1983) article raises a number of interesting points with regard to the age and significance of red soils and also the efficacy of glacial erosion in western Britain.

At Laddray Wood, Cumbria, a site visited by the QRA in May 1981, (Boardman, 1981 pp 16-21), a weakly developed Bt horizon attains a 10R hue where the parent material is a brown (10YR 4/4) till. The soil was originally interpreted as a pre-Devensian paleosol due to the presence of such soils in the area and an over-reliance on soil colour as a paleoclimatic indicator. Further investigation showed that the soil is developed in late Devensian clayey till and was subsequently buried sometime after 2400±80 (HAR-3704) years BP. The red soil is, therefore, considered to be of Holocene age. The development of red coloration cannot be related to former interglacial climates as much of the literature suggests. The point was made during the QRA visit to the site that red coloration is not uncommon in Holocene soils in Britain, particularly where it occurs on structural faces rather than in the soil matrix. It was also suggested that periodic waterlogging of such clayey soils may be responsible: it is a gley feature.

Lawson (1983) reports that haematite has been detected in the Inch-nadamph soil. Assuming that it is not inherited from local rocks, this may be an important observation. Red coloration at Laddray Wood is not due to haematite; lepidocrocite appears to be the only crystalline iron oxide present (XRD). Unfortunately, the majority of studies of red soils fail to report the iron oxide species present, an exception being the paleosol described by Bullock *et al* (1973) from a site outside the Devensian ice limit on the North Yorkshire Moors.

Rubification due to the development of haematite may be a valid indication of climate warmer than the present; red colours caused by other iron oxides may not reflect greater warmth. The subject is complicated by lack of information on iron oxides in soils - certainly British soils; by the difficulty of identifying the oxides; by the influence of soil moisture regime; and by the possibility of post-formational intensification of colour (Gerasimov, 1971). A major problem is the identification of small amounts of haematite which may influence soil colour. Conventional XRD techniques are not sufficiently sensitive and, therefore, others are beginning to be used e.g. Mossbauer spectroscopy (Murad and Schwertmann, 1980).

However, it seems unwise to assume that Holocene soils in western Europe cannot develop a considerable degree of redness. At present, it is unclear as to whether, in all cases, this results from haematite formation, and if so, the exact relation to climate. Two recent studies of rubified soils are relevant to this discussion; both describe soils on well drained, calcareous parent material in moist temperate environments, and of 2.5YR hue. Schwertmann *et al* (1982) record the presence of haematite whereas Bresson (1974) does not. Bresson's sites in the Jura are climatically similar to Laddray Wood at the present time, though

they differ texturally. Duchaufour (1982) suggests that rubification has occurred during the Holocene where conditions have been ideal: well drained parent materials, warm dry summers, and sufficient rainfall to decalcify calcareous material. In contrast, at Laddray Wood, rubification is associated with a poorly drained soil containing many gley features.

At Laddray Wood the use of soil micromorphological techniques was particularly valuable (Boardman, 1981). Red ferri-argillic coats are associated with channels, chambers, ped faces and stones, but the matrix is unaffected. A monophasic development of pedological features is suggested - argillic coats are in existing voids and have not been disrupted. Such criteria have been found useful in distinguishing ordinary argillic horizons developed in Devensian deposits during the Holocene, from paleo-argillic horizons developed in pre-Devensian interglacials (Bullock, 1974; Avery, 1980). Micromorphological examination may, therefore, help clarify the age of the soils described by Lawson (1983). It might also be of value in assessing whether red coloration is a soil feature developed *in situ* or if weathered material had been washed into the Creag nan Uamh cave.

The second major point raised by Lawson (1983) is that of the unlikely survival of pre-Devensian soils in a glaciated area such as Assynt.

In the Mosedale and Thorns Gill area of northeastern Cumbria, a pre-Devensian soil, the Troutbeck Paleosol, reaches a thickness of 14m at Caral Gully and outcrops intermittently over an area of 8km². It has survived the late Devensian glaciation of the region (Boardman, 1980; 1981a), because of its location in a buried bedrock valley oriented normal to the direction of ice flow. Some erosion of the upper horizons of the paleosol has occurred and these are incorporated in the overlying Devensian till. However, the erosion was limited to a few metres at the most. The relative lack of erosion is particularly significant because the buried valley in which the paleosol is preserved, lies close to the base of a deep glacial trough which served as a major exit route for ice from the central Lake District. It is, therefore, difficult to imagine a warm-based ice sheet, basal sliding and high erosion rates in this trough during the late Devensian glaciation. Erosion of the trough, including the truncated spurs of Blencathra (NY 3226), must have been accomplished by a pre-Devensian ice sheet or valley glacier, such as that which deposited the pre-Devensian till in the area.

Sugden (1969) also remarks on the lack of erosion accomplished by the Devensian ice sheet in the Cairngorms. This is less surprising than in the Lake District since a more continental climatic regime and thinner ice at high altitudes, may have resulted in a polar ice sheet. It may be that during the late Devensian glaciation conditions in the Lake District were similar. A model of the late Devensian ice sheet at its maximum shows basal ice at the melting point only around the extremities of the British ice sheet, and most certainly not in the Lake District (Boulton *et al.*, 1977). At this time the Lake District was about 300km north east of the ice sheet margin in the southern Irish Sea and remote from maritime influence.

Thus, a combination of limited protection afforded by a bedrock valley and the probability of little basal sliding appears to have minimised erosion of pre-Devensian deposits and soils in the Mosedale and Thornsgill area. Although the area of outcrop of the Troutbeck Palaeosol is restricted, its survival implies that low rates of glacial erosion were characteristic of the base of a major glacial trough during the late Devensian. The reason for this must relate, in part, to temperature conditions beneath the ice sheet and may be applicable elsewhere in the region of northwestern Britain.

Acknowledgements

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References

- Avery, B.W. 1980. Soil classification for England and Wales (Higher Categories) *Soil Survey Technical Monograph* No.14.
- Boardman, J. 1980. Evidence for pre-Devensian glaciation in the north-eastern Lake District. *Nature* 286, 599-600.
- Boardman, J. 1981. *Field Guide to Eastern Cumbria* (ed. J. Boardman). Quaternary Research Association.
- Boardman, J. 1981a. Quaternary Geomorphology of the northeastern Lake District. Unpublished PhD thesis, University of London.
- Boulton, G.S., Jones, A.S., Clayton, K.M., and Kenning, M.J. 1977. A British ice-sheet model and patterns of glacial erosion and deposition in Britain. In, Shotton, F.W. (ed.) *British Quaternary Studies: Recent Advances*, Clarendon Press, Oxford, 231-246.
- Bresson, L.M. 1974. A study of integrated microscopy: rubefaction under wet temperate climate in comparison with Mediterranean rubefaction. In, Rutherford, G.K. (ed.) *Soil Microscopy*, Limestone Press, Kingston, Ontario, 526-541.
- Bullock, P. 1974. The use of micromorphology in the new system of soil classification for England and Wales. In, Rutherford, G.K. (ed.) *Soil Microscopy*, Limestone Press, Kingston, Ontario, 607-631.
- Bullock, P., Carroll, D.M., and Jarvis, R.A. 1973. Palaeosol features in Northern England. *Nature Phys. Sci.* 242, 53-54.
- Duchaufour, P. 1982. *Pedology*, George Allen and Unwin.

- Gerasimov, I.P. 1971. Nature and originality of palaeosols. In, Yaalon, D.H. (ed.) *Origin, Nature and Dating of Palaeosols*, International Society of Soil Science and Israel University Press, 15-27.
- Lawson, T.J. 1983. A note on the significance of a red soil on dolomite in northwest Scotland. *Quat. Newsl.* 40, 10-12.
- Murad, E., and Schwertmann, U. 1980. The Mossbauer spectrum of ferrihydrite and its relations to those of other iron oxides. *Am. Mineral.* 65, 1044-1049.
- Schwertmann, U., Murad, E., and Schulze, D.G. 1982. Is there Holocene reddening (hematite formation) in soils of axeric temperate areas? *Geoderma* 27, 209-223.
- Sugden, D.E. 1969. The age and form of corries in the Cairngorm mountains, Scotland. *Scott. Geogr. Mag.* 85, 34-46.

REPORT ON A SHORT FIELD MEETING TO NORTH-EAST YORKSHIRE

16th - 18th September, 1983

by C. A. Edwards

Twenty four members assembled at the Hylands Hotel, Filey on the evening of September 16th. The purpose of the meeting was to examine the geomorphology and Quaternary stratigraphy of the Vale of Pickering and Filey Bay. The excursion was led by Dr. Andrew Edwards.

Day 1. The excursion began by visiting Heselton sand pit (SE 916766) to examine a sequence of sands overlapped to the north by an increasing thickness of angular chalk gravel. The sands contained palaeocurrent structures indicating a northerly flow of water from the chalk scarp of the Yorkshire Wolds into the Vale of Pickering thus provoking Jim Rose to suggest that they may have originated as cover sands on the Wolds. Features resembling slender ice wedge casts were closely inspected and it was suggested that some of these may have been produced by root penetration of Flandrian vegetation. Members also saw good examples of sand dykes. The overlapping angular chalk gravel displayed excellent south to north imbrication and several well developed ice wedge casts. These were eagerly excavated and seen to extend several metres into the underlying sand. Heselton sand pit provided a stimulating beginning to the day and the convoy of cars then moved to Knapton gravel pit (SE 889 749).

Here, members were shown steeply dipping angular chalk gravel which had been derived from the chalk scarp and water transported over a short distance. The gravel pit has been extensively back filled, obliterating much of the good exposure seen in the past but it was still possible to see shattered chalk bedrock which is detached from the main mass of the chalk scarp at around the level of the Chalk/Spheeton Clay contact. Members debated whether the chalk gravel had been draped over the chalk ridge by ice melt or whether the detached east-west trenching ridge had intruded the overlying gravel due to overburden bulging of the underlying Spheeton Clay.

The party then repaired to the Spotted Cow in Malton where refreshments were consumed sat outside in glorious sunshine.

After lunch, Golden Hill quarry revealed a gravel deposit infilling a channel on the hill crest. Ron Jarvis, Jim Rose and others discovered that rounded Jurassic sandstone clasts in the deposit were coated in well developed clay skins and that rubification had also occurred. This led to a discussion on the possibility of the deposit being an Ipswichian palaeosol, much to the delight of John Boardman.

Newtondale and the Hole of Horcum were viewed next from the vantage point close to Hazelhead Moor. Spring sapping at the base of the Corallian outcrop was generally agreed to be responsible for forming the Hole of Horcum though a polygonal network on the Oxford clay surface was attributed either to Devensian cold or the recent hot weather.

A nearby ice cream van serving most generous cornets prevented Charles Turner and others with spades from descending into the Hole of Horcum and carrying out an excavation.

In Thorntondale the old railway cutting (SE 842827) exposed two metres of a previously much deeper section and a clean face was soon excavated. Following his earlier experience at Golden Hill Quarry, the excursion leader adopted a more non-committal role than previously and allowed the solifluctionists to argue their case against the tillites. Whilst the former said that all the erratics present were from the moorland surface to the north and transported south by solifluction, the latter drew attention to the weathered till-like appearance of the section. Later that evening Andrew Edwards produced macrofabric analyses from various sites in Thorntondale which suggested that the deposit was till. However, the matter was not fully resolved as the deposit may be older than Devensian thus the Devensian Vale of Pickering ice limit is still debatable.

En route to Filey a brief stop was made at the Hutton kame terrace where Albert Franks described some of the detailed sections he had seen and suggested the deposit was largely formed by water draining from Irton Moor. This is in keeping with the eastward extension of the feature beyond Forge Valley and the altimetric incompatibility of kame surface and the valley floor.

After a fine dinner at the Hylands Hotel, members met in Binkey's wine bar to discuss the day's proceedings.

Day 2.

The second day was spent examining coastal till sequences in Filey Bay. The party was joined by civil engineering undergraduates from Brighton Polytechnic and began by investigating the two tier till sequence overlying the glacially disturbed Corallian bedrock of Filey Brigg. The sands and gravels sandwiched between the two tills provoked much discussion, of which some were held in precarious situations high on the cliffs. Cees Laban and Rund Schuttenhelm described their work for the Netherlands Geological Survey in the North Sea basin which dispels any notion of Devensian Scandinavian ice occupying the area. They suggested that British Devensian ice flowed inland due to response to ice surface gradients and the resistance to eastward movement caused by the topographic high of Dogger Bank.

After a cafe lunch in Filey a convoy of cars headed for Reighton Gap where Andrew Edwards demonstrated how to break into a Ford car after his wife locked the keys inside. (Several members availed themselves of the necessary technology). The party then walked to the Speeton Clay and Shell Bed outcrop where it was attempted to show the tectonic features of the Shell Bed seen in 1975. However, continued landslips and the dry summer made it difficult to obtain clean outcrop faces and members needed much goodwill and imagination to see the extent and scale of folding and faulting observed previously.

Above the Speeton Shell Bed, discussion centred on the narrow band tills which are in marked contrast to the thicker lodgement till of Filey Brigg. Andrew Edwards suggested that they were produced by en-glacial shearing caused by ice advancing against the rising ground of Flamborough Head. Observed variations in macrofabric data appeared to support this hypothesis.

The party then descended to the beach where P. Worsley rather fittingly proposed a vote of thanks on the very spot where my researches began in 1973.

Andrew Edwards.

OBITUARY

Francis M. Synge
1923 - 1983

It was with great sadness that the Quaternary Research Association learnt of the death of its Vice-President, Francis Synge, on 1st October 1983. His passing will be a great loss to the Association and to Quaternary Geology at large, but most of all he will be missed for his quiet enthusiasm about the subject of ice limits and displaced shorelines, and the selfless encouragement he gave to all those wishing to share his interest. In many respects Francis Synge heralded in the concepts of the last thirty years, yet maintained and developed the tradition of reading the landscape based on the skill and experience of field mapping in many parts of the world.

Francis Millington Synge was born in Dublin on 26th May 1923. He took a first degree in Geography and Geology at Trinity College, Dublin during which he received the Edge Prize in Geology. This was followed by an MSc degree awarded in 1948, for which he investigated the nature of eskers and meltwater drainage in County Meath, and at the same time reaped the benefits of fieldwork and discussion with Tony Farrington of the Royal Irish Academy. In 1950 he took up an appointment as Cartographer at the University of Aberdeen developing his considerable skills of diagrammatic representation and producing most of the maps and diagrams for O'Dell's 'Scandinavian World'. It was during this period also that he first met his future wife, Margaret, and carried out his investigation into the glaciation of north-east Scotland.

In 1957 he returned to Ireland to become an Officer of the Geological Survey of Ireland, mapping parts of Sligo, Limerick and West Mayo, and extending his personal interest to County Wexford and (using the ferry and push-bike) the Llyn Peninsula of west Wales. It was during this time that he established a working partnership with Nick Stephens, then a lecturer at Queen's University Belfast, and spent five months seconded to the Finnish Geological Survey. Already with wide experience this stay in Scandinavia was to have considerable influence on the future development of his ideas about glacial landforms and in particular his interest in isostatically displaced shorelines.

After working with the Geological Survey of Ireland until 1963, he joined the Department of Geography at Queen's University Belfast where, apart from continuing his research, he played a significant part in compiling the Irish contribution to the Field Excursion Guide for the I.G.U in 1964. From 1964 to 1966 he was Research Fellow in the Department of Geography at the University of Leicester contributing along with John Rice, Winifred Tutin and Trevor Ford to one of the first undergraduate courses to be offered in this country on the subject of Quaternary Studies. During the summer of 1965 he did fieldwork in Baffin Island in response to an invitation by Wes Blake of the Canadian Geological Survey.

In 1966 he returned to Aberdeen, this time as lecturer in the Department of Geography. These were busy days with active fieldwork in Scotland and north-east Ireland and expeditions to Scandinavia, in addition to creating and teaching a new undergraduate course. Somehow he found time to continue courting and in July 1968 he at last married Margaret at Aboyne on Deeside. On 1st May 1969 he returned once more to Ireland as Senior Specialist Geologist in charge of the Quaternary section of the Geological Survey of Ireland. In this role he had the task of mapping Quaternary deposits in Ireland and providing a background for the investigation of aggregate and other mineral resources. In conjunction with Willie Warren and other colleagues in the Quaternary Section six inch mapping of County Wicklow was completed along with parts of Counties Wexford, Kildare and Meath. At the same time he maintained his interest in existing research projects continuing his study of displaced shorelines elsewhere in Ireland and the Isle of Man, his study of ice-limits and shorelines in Highland Scotland along with John Smith of Aberdeen, and his study of shorelines and moraines in Scandinavia. In December 1981 he was awarded an Sc.D. by Trinity College, Dublin.

During this time he was elected to be the first Chairman of IQUA and Vice President of the Quaternary Research Association. He was Irish Delegate to INQUA in 1973, 1977 and 1983, although on the last occasion he could not attend because of illness. He also arranged and lead many field meetings including two for the 1977 INQUA and four for the QRA (three to Ireland and one to the Inverness region of Scotland). It was during the latter part of his appointment with the Irish Geological Survey that he first became aware of his illness and, despite fighting it with tremendous energy and will, he continued to pursue his research and attend academic meetings. Not least the Annual Meeting of the Q.R.A. in the Netherlands at Easter 1982. He retired on the 1st May 1983 but continued, as far as he was able, to pursue his research and publication, with the result that material is still in press or about ready for publication.

In many respects much of the work of Francis Synge was ahead of its time so that it was either initially ignored or disputed, yet in many cases the observations and ideas have been vindicated with the passing of time, or at least understood in the perspective for which they were written. For instance, when he published his paper on the glacial deposits around Trim, County Meath he put forward views about esker formation and subglacial drainage that only became generally accepted in the late 1950's and 1960's. Likewise, his papers considering the retreat stages of the Last Ice-Sheet in the British Isles are only now being critically tested with the availability of new dating methods. Twenty-five years after the publication of 'The Glaciation of North-east Scotland' Sissons stated that 'none of Synge's ice-free area can be disproved on present evidence'. Although many of the views about isostatically displaced shorelines have generated major controversy, this in itself has contributed to the development of the subject, and Synge himself has modified his view accordingly in papers that have only recently been published. The significance of these later ideas will only be tested with time.

Although Francis Synge will long be remembered for his written contributions to Quaternary Geology he will also be remembered by those who knew him for his selfless attitude to his work and the pleasure he gave in pursuing it. This characteristic was appreciated most by research students and those just beginning their careers, such as David Prior, John Smith, Roger Crofts, Peter Worsley and myself; and more recently by James Scourse, all of whom I am sure would agree have gained so much from his enthusiasm, skill in the field, and investigation of explanations. Equally, I have no doubt that all of us, and many others, can remember with immense pleasure improbable adventures that seemed inevitably to garnish each field trip. Combined with this was his patience in explaining again and again, difficult concepts; and his readiness whenever he could not convince to return to the field to check the field evidence. This pleasure experienced by so many was best of all experienced by his wife Margaret and his son Ian. Time and again they saw ideas develop, experienced the enthusiasm of them maturing, then ended up on holiday 'just next to a critical site'. The sadness felt by members of the Association is little compared to that felt by his family, but we can hope, at least, that they will also gain pleasure from his memory and from the knowledge of the great affection in which he was held by others.

J. Rose

LIST OF PUBLISHED WORK

- 1946 - The Glendalough Valley. *Ir. Geogr.*, 1, 58-61.
- 1948 - The Kilmacanoge Valley. *Ir. Geogr.*, 2, 20-24.
- The origin of Eskers as illustrated by the Late-Glacial Deposits around Trim, Co. Meath. *Unpublished M.Sc. thesis, Department of Geography, Trinity College, Dublin.*
- 1950 - The Glacial Deposits around Trim, Co. Meath. *Proc. R. Ir. Acad.*, 53B, 99-110.
- 1952 - Retreat stages of the last ice-sheet in the British Isles. *Ir. Geogr.*, 2, 168-171.
- 1954 - (Kirk, W. & Synge, F.M.). Farms of Verdal, Norway. *Scott. geogr. Mag.*, 70, 106-123.
- 1956 - The Glaciation of North-East Scotland. *Scott. Geogr. Mag.*, 72, 106-123.
- 1958 - (Stephens, N. & Synge, F.M.). A Quaternary Succession at Sutton, Co. Dublin. *Proc. R. Ir. Acad.*, 59B, 19-27.
- .. - Geology of the neighbourhood of Sligo. *Sligo Champion*, May 17th 1958.
- 1960 - The Quaternary Period in Ireland - An assessment, 1960. *Ir. Geogr.*, 4, 121-130.

- 1963 - A correlation between the drifts of South East Ireland and those of West Wales. *Ir. Geogr.*, 4, 360-366.
- .. - The glaciation of the Nephin Beg Range, County Mayo. *Ir. Geogr.*, 4, 397-403.
- .. - The Quaternary succession round Aberdeen, North-East Scotland. *Rep. Vith. Int. Congress on Quaternary, Warsaw 1961.*, 3, Geomorph. Sect. 353-361.
- 1964 - The Glacial Succession in West Caernarvonshire. *Proc. Geol. Assoc.*, 75, 431-444.
- .. Some problems concerned with the glacial succession in south-east Ireland. *Ir. Geogr.*, 5, 73-82.
- 1965 - (Stephens, N. & Synge, F.M.). Late Pleistocene shorelines and drift limits in north Donegal. *Proc. R. Ir. Acad.*, 64B, 131-153.
- .. - Sheet 5, (Ireland). *International Quaternary Map of Europe.* INQUA, Hannover.
- 1966 - The Relationship of the Raised Strandlines and Main End-Moraines on the Isle of Mull, and in the District of Lorn, Scotland. *Proc. Geol. Assoc.*, 77, 315-328.
- .. - (Stephens, N. & Synge, F.M.). Pleistocene Shorelines. In G.H. Dury (ed.): *Essays in Geomorphology*, 1-51. Heinemann, London.
- .. - (Kirk, W., Rice, R.J., & Synge, F.M.). Deglaciation and Vertical Displacement of Shorelines in Wester and Easter Ross. *Trans. Inst. Br. Geogr.*, 39, 65-78.
- .. - (Synge, F.M. & Stephens, N.). Late- and Post-glacial Shorelines, and Ice Limits in Argyll and North-east Ulster. *Trans. Inst. Br. Geogr.*, 39, 101-125.
- .. - (Finch, T. & Synge, F.M.). The drifts and soils of West Clare and the adjoining parts of Counties Kerry and Limerick. *Ir. Geogr.*, 5, 161-172.
- .. - Glacial Geology (of Co. Limerick). In T. Walsh (Director) & P. Ryan (ed.): *Soils of Co. Limerick, The Agricultural Institute, Dublin.* National Soil Survey Bull. 16, 12-20.
- 1967 - Written Contribution to the Discussion of a Paper previously taken as read: 3 April 1964. *Proc. Geol. Assoc.*, 78, 347-350.
- 1968 - The glaciation of west Mayo. *Ir. Geogr.*, 5, 372-386.
- 1969 - The Worm Ice Limit in the west of Ireland. In Quaternary Geology and Climate, Publication 1701, *National Academy of Sciences, Washington, D.C.*, 89-92.
- .. - The raised shorelines and deglaciation chronology of Inari, Finland and South Varanger, Norway. *Geogr. Annl.*, 51A, 193-206.

- 1970 - The Pleistocene Period in Wales. In C.A. Lewis (ed.): *The Glaciations of Wales and Adjoining Regions.*, 315-350. Longman, London.
- .. - The Irish Quaternary: Current Views 1969. In N. Stephens & R.E. Glasscock (eds.): *Irish Geographical Studies*, 34-48, Department of Geography, The Queen's University, Belfast, in honour of E. Estyn Evans.
- .. - (Farrington, A. & Synge, F.M.). The Eskers of the Tullamore district. In Three local studies of the Irish Pleistocene (1)., N. Stephens & R.E. Glasscock (eds.). The Queen's University, Belfast, in honour of E. Estyn Evans. *Irish Geographical Studies*, 49-52.
- .. - An analysis of the glacial drifts of south-east Limerick. *Geol. Surv. Ireland. Bull.*, 1, 65-71.
- 1971 - The glacial deposits of Glenasmole, County Dublin, and the neighbouring uplands. *Geol. Surv. Ireland. Bull.*, 1, 87-97.
- 1973 - Glacial Geology (of Co. Leitrim). In T. Walsh (Director) and M.J. Gardiner (project leader): County Leitrim Resource Survey, *The Agricultural Institute*, Dublin, Soil Survey Bull. 29, 15-17. ISBN 0-901317-67-5.
- .. - The glaciation of south Wicklow and the adjoining parts of the neighbouring counties. *Ir. Geogr.*, 6, 561-569.
- 1977 - Land and sea level changes during the waning of the last regional ice sheet in the vicinity of Inverness. In *The Moray Firth Area - Geological Studies*. Inverness Field Club, Inverness, 83-102.
- .. - Records of sea levels during the Late Devensian. *Phil. Trans. R. Soc. Lond.*, B. 280, 211-228.
- .. - The coasts of Leinster (Ireland). In C. Kidson & M.J. Tooley (eds.): *The Quaternary History of the Irish Sea*, 199-222. Seal House Press, Liverpool.
- .. - (Huddart, D. & Cohen, J.M., Culleton, E., Hoare, P., McCabe, A.M., Mitchell, G.F., Synge, F.M.). Guidebook for Excursion A14, South East Ireland. International Union for Quaternary Research (INQUA) X Congress 1977. Geo Abstracts Ltd., University of East Anglia, Norwich, NR4 7TJ.
- .. - (Lewis, C.A. & Bryant, R.H., Quinn, I., Synge, F.M., Warren, W.P.). Guidebook for Excursion A15, South and South West Ireland. International Union for Quaternary Research (INQUA) X Congress 1977. Geo Abstracts Ltd., University of East Anglia, Norwich, NR4 7TJ.
- .. - (Finch, T.F. & Orme, A.R., Synge, F.M.). Guidebook for Excursion C16, Western Ireland. International Union for Quaternary Research (INQUA) X Congress 1977. Geo Abstracts Ltd., University of East Anglia, Norwich, NR4 7TJ.

- 1977 - (Oppenheim, M.J., Bruck, P.M., Elsdon, E., Synge, F.M., Weaver, A., and Warren, W.P.). Eskolaite CR_2O_2 from County Wicklow, Ireland. *Min. Mag.* 41, 402-403.
- 1979 - (Rose, J. & Synge, F.M.). Glaciation and shoreline development between Nydal and Haukdal, south Varangerfjorden, north Norway. *Quaes. Geogra.* 5, 125-151.
- .. - Quaternary glaciation in Ireland. In Prospecting in areas of glaciated terrain 1979, *The Institution of Mining and Metallurgy, London.*, 1-7. ISBN 0 900488 46 9. ISSN 0141-3376.
- (Synge, F.M. & Warren, W.P., Culleton, E.B., Huddard, D.A., McCabe, A.M.). Quaternary Research Association (QRA), Field Guide, East Central Ireland, Annual Field Meeting 1979. Published Dublin April 1979.
- .. - Glacial Drift (Plates 18 & 19) and Glacial Landforms (Plate 21). In *Atlas of Ireland*. Royal Irish Academy, Dublin.
- 1980 - (Synge, F.M. & Smith, J.S.). Quaternary Research Association (QRA), A Field Guide to the Inverness area, May, 1980.
- .. - Quaternary Period. In An Introduction to the Geology of Ireland, by D. Naylor, W.E.A. Phillips, G.D. Sevastopulo and F.M. Synge. Prepared for the 26th International Geological Congress, 1980. Published under the auspices of the Irish National Committee for Geology of the Royal Irish Academy., 39-42.
- .. - (Colhoun, E.A. & Synge, F.M.). The cirque moraines at Lough Nahanagan, County Wicklow, Ireland. *Proc. R. Ir. Acad.*, 80B, 25-45. ISSN 0035-8983.
- .. - Late glacial shorelines in south Finland. *Geol. Surv. Finland Rep.* 46., 1 - 29. ISBN 951-690-125-5. ISSN 0430-5124.
- .. - A morphometric comparison of raised shorelines in Fennoscandia, Scotland and Ireland. *Geol. For. Stockh. Forh.*, 102(3), 235-249. ISSN 0016-786X.
- .. - Raised beaches in Ireland. *Bulletin de l'Association française pour l'Etude du Quaternaire*. 1 (2), 77-79.
- 1981 - Quaternary glaciation and changes of sea level in the south of Ireland. *Geol. Mijnbouw* 60: 305-351.
- .. - Contributions: Chapters 6 and 7. In G.L. Herries-Davies and N. Stephens: *Ireland*, 115-221. Methuen, London.
- 1982 - A new shoreline chronology for the Salpausselkas. *Ann. Acad. Sci. Fennicae A. III.* 134 (1982), 29-60.

Posthumous

1983 - Foundations: The Geology of Laois, Part 2: The Quaternary Period: the Ice Age and its Deposits. *LAOIS an Environmental History*, 49-57. Ballykilcavan Press, Stradbally.

In - Coastline Evolution. In K. Edwards and W.P. Warren (eds.)
Press *The Quaternary of Ireland*. Academic Press, London.

Obituary

David M. Hodgson

The sudden and unexpected death of Dr David Hodgson has removed from Quaternary science one of its most gifted young scientists. David, aged 27, was tragically killed during a lightning storm in Sierra Leone on 27th November, 1983. He was awarded his doctorate from the University of Edinburgh in 1982 having completed his thesis on hummocky and fluted moraines in part of North-West Scotland. Sincere condolences are extended to his wife, Helen, and family.

ABSTRACT OF A RECENT THESIS

Quaternary Geomorphology of the Assynt area, northwest Scotland

T.J. Lawson

Ph.D. Thesis, University of Edinburgh, 1983

The main factors influencing the distribution of geomorphic features in the Assynt area are geology, and the location of Loch Lomond Advance glaciers. A study of glacial striae and erratics has enabled the construction of a model for the development of the last ice sheet. Glaciers developed in the corries on the north and east side of the Assynt mountains, coalesced and thickened until an ice divide was established, ice overtopping the mountain ridge to flow both eastwards and westwards; the ice divide was always situated to the east side of the mountains. Even the highest parts of the study area were covered by ice to a considerable depth. After deglaciation of the area, seven glaciers subsequently formed during the Loch Lomond Stadial. Reconstruction of these glaciers has shown that the main snow-bearing air-streams came from the south and that the blowing of snow onto glacier surfaces was a major factor in their development.

Glacial friction cracks are widespread in the Assynt area. A revision of nomenclature and a simplified classification is suggested. Attempts have been made to characterise certain Assynt friction crack forms, and orientation studies suggest that they are useful ways of establishing the former ice-flow direction when striae or ice-moulded bedrock are absent, as long as a large number of them are measured. Their orientation is sometimes affected by weaknesses in the bedrock.

A study of the caves in the Cambrian dolomite of the area indicates that they originated phreatically, but subsequent lowering of the local water-table has tended to result in high-level, abandoned passages, often choked with clastic deposits, and lower-level passages containing the active streamways. Clastic cave sediments are largely allochthonous, being derived from local glacial deposits. The dating of certain calcite speleothems has shown that many of the main elements of the subterranean drainage network were in existence prior to the last glaciation, and some parts may pre-date the penultimate interglacial. The Creag nan Uamh caves have yielded a unique Devensian and Flandrian fauna, and also evidence for the earliest recorded existence of man in Scotland, dated by radiocarbon to $10,080 \pm 70$ years B.P.

REVIEWS

Basic Geological Mapping. By J.W. Barnes 1981. Open University Press, Milton Keynes. 112pp. Price £5.50 (softback)

The book is one of a series of Geological Society of London handbooks designed primarily to assist students undertaking unsupervised fieldwork. The book includes chapters on instruments and equipment, geological maps and base maps, methods of geological mapping,

field measurements and techniques, rocks, fossils and ores, field maps and field note books, fair copy maps, illustrations and sections and an appendix on safety in the field. The list of contents is very detailed and this to some extent makes up for the lack of an index.

The text stresses the importance of the geological map as the basis for all further studies and the essential requirement of precisely recording the facts on which the map is based. The coverage is complete but uneven; 'hard' rocks are very comprehensively discussed in comparison to 'soft' rocks and drift deposits.

The section on instruments and equipment is excellent except that a hammer is of much less importance to a Quaternary stratigrapher than an auger or trenching tool. The geological maps chapter provides a good introduction to the student though a slight omission in Table 3.1 suggests that they have giant paces. Chapter 4 clearly describes the various methods of map making. The traversing and exposure method are stressed without stating that these are most appropriate to reconnaissance mapping and to hard rock areas. Much of the geology of Great Britain is 'poorly exposed' and a combination of the author's contact mapping and traverse mapping is more appropriate to Mesozoic and drift-covered areas. The value of feature mapping needs to be stressed and the need to establish the relationship between such features and formation boundaries and dip. Without this the student may be led to the error of tram-lining outcrops between exposures rather than walking out and recording the secondary information as described clearly in the text.

More space could have been given to the section on fold structures, probably at the expense of description of strike and dip. In doing so the explanation of the nature of fold crests and hinges, of multiple folding, and the relationship between bedding and cleavage could have been enhanced. With a few exceptions the illustrations are clear and concise.

The author stresses the importance of making the map in the field, only varying it in the office if necessary, where there is additional geophysical or palaeontological information, although such data should affect interpretation rather than the mapped boundaries of lithological units. The sections on map making and section drawing are lucid. The significance and use of field note books are clearly described.

Despite its emphasis on pre-Quaternary deposits, the book provides an excellent guide and framework for the student to enhance his training in mapping in the only place that it can be done, the field. At less than A5 size the book should be in the pocket of every budding field surveyor. How long will we have to wait for a companion volume on geomorphological mapping, which could include greater emphasis on the study and description of soft rocks and drift deposits in particular?

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Scotland's Environment during the last 30,000 years. By R.J. Price
244 pp, figs, plates. Scottish Academic Press: Edinburgh 1983
price £27.50 hardback, £15.00 softback ISBN 0 70730325 7.

This is the first book to tackle the Scottish Quaternary explicitly from the palaeoenvironmental angle. After an examination of the present physical environment, Dr. Price discusses palaeoenvironmental changes in four chapters; Scotland before the last glaciation, the last ice sheet, the late-glacial period, the early Post-glacial period and the last 5,000 years, including the increasing impact of man on the environment. The book closes with a section on the prospect for the future and future research. The scope of the task Dr. Price has set himself and the variety of disciplines covered is reflected in 16 pages of references. On the technical side production is to a high standard (with the exception of some of the photographs), but at the price (£27.50 hardback, £15 softback) one would expect a listing of the figures and plates. The book is aimed at a wide audience though I wonder whether those who need to have glacial striations explained will be able to cope with terms like 'minerogenic' and with the pollen diagrams.

A number of errors and misprints have crept through. For instance, on p.4 the Ochil hills are formed of Devonian, not Carboniferous lavas. The three arctic ostracods *Krithe glacialis*, *Cythero-*opteron montrosiense** and *Rabulimys mirabilis* (p.105) are characteristic of the Errol beds and not the Clyde beds, an important distinction. The river labelled as R Spean in Fig.4.18A is the River Spey. There are a fair number of spelling mistakes eg Table 4.2 'gyttja'... Figs.4.1 and 4.3 'gytja'. The Glen Gloy lake (p.128, top) overflowed into the Glen Roy lake, not the River Spey. On Fig 4.7, which shows the marine limit for the Late-glacial interstadial, some of the values almost certainly date from prior to this period. The vital *Pinus* curve has been inadvertently omitted from Fig.5.10B. I would quibble with the term 'glacial till' as till is by definition a glacial deposit.

As Dr. Price observes, sites of palaeoenvironmental significance prior to the last glaciation are scarce in Scotland and the information on the pre-Late Devensian period correspondingly limited. He has, therefore, turned to English sites and (rather uncritically in view of his comments on dating) to deep sea boreholes to provide a framework for estimating air temperatures on the Scottish mainland for the earliest part of the Devensian stage. For the Late-glacial and Post-glacial periods the treatment mirrors the wealth of literature on some aspects of the geomorphology and palynology but the well-dated near-shore marine thermal maximum at 11,000 BP is not mentioned. The Loch Lomond stage (Advance or Readvance according to taste despite the strictures regarding the latter on p.114) receives extended coverage, but there is little discussion of the retreat stages (if any) of the main Devensian ice and of the question of readvances interrupting the retreat. Though there may be little direct evidence for climatic conditions between 18,000 and 14,000 BP (p.86) the distribution of the arctic Errol beds surely indicates a very cold climate in deglaciated eastern Scotland at a time when western Scotland was still ice-covered.

Radiocarbon dating takes a hammering (p.91-100) on the basis of a tabulation of Scottish dates from the Late-glacial into the early Post-glacial periods (Table 4.2). Dr. Price concludes "It must be admitted, therefore, that radiocarbon dating as presently practised is unsuitable for dating faunal, floral and by implication, climatic changes in the Scottish Late-glacial." There is certainly much to shudder at in Dr. Price's catalogue, but it would have been pertinent to take the discussion further by examining dates on different types of organic matter. Organic mud and gyttja seem to be the culprits. Marine shell ages (normalised and non-normalised ages are confused in Table 4.2) give a reasonable chronology on the whole and selection of material to be dated is certainly at least part of the problem (and the answer).

It is impossible in a short review to cover the numerous topics which engage the attention in this book, which is, despite my previous remarks, a mine of information and an up-to-date account of the Scottish scene (to early 1982 according to the references). I would have liked to have seen a little more discussion about the sea-level curves for the Post-glacial period, particularly the anomalous Solway curve (p.156), and their relationship to those from the north of England. As regards the future, Dr. Price emphasises the value of the interdisciplinary approach and the need for more basic and accurate data. To this can be added the increasing importance of sedimentology and the exploration of the continental shelf as the link between the deep sea and the land. In short, the strengths and weaknesses of this book are largely a reflection of the present state of Quaternary studies in Scotland. It is a 'must' for those with a general or research interest in the topic. If you can't afford the paperback version, make sure your library obtains the hardback.

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Quaternary of South America and Antarctic Peninsula, volume 1,
Ed. Jorge Rabassa, A.A. Balkema, Rotterdam, 1983. ISBN 90 6191
513 9; £12.20.

"'Quaternary of South America and Antarctic Peninsula' will publish scientific works, reviews and short notes and comments on any field related to the problems of the Quaternary in these geographical regions, with a strong emphasis in the palaeoenvironmental and palaeoclimatic approach." This statement from the Foreword to volume 1 implies that a series of books may be forthcoming, but no details are given. A series of volumes on this topic would indeed be an exciting prospect, particularly in view of another claim made, namely that "it is in South America and the Antarctic Peninsula where key evidence to understand the mechanism of the onset of glaciation could be found."

This volume contains a selection of papers delivered at the South American Regional Meeting, INQUA Commission on Lithology and Genesis of Quaternary Deposits, held in Nequén, Argentina, in March 1982.

Most papers delivered at the meeting were on tills and related deposits and have been published separately (Evenson et al 1983). The papers assembled here are a curious mixture of topics ranging from a biography to archaeology. Clearly the volume is a vehicle for publishing the interests of individuals who participated in the conference. The only common theme is that the papers deal with South America in the Quaternary; there are no papers on the Antarctic Peninsula.

The book contains eleven chapters and opens with a brief tribute to the late Carl C:zon Caldenius, a Swede who made an outstanding contribution to the Quaternary of Argentina in his capacity of State Geologist, 1925-1930. His major publication (Caldenius 1932) is still the most detailed and comprehensive account of glaciation in Patagonia.

Chapter 2, "Quaternary palynology of Chile" (Heusser), is a valuable and comprehensive review of the author's work (spanning 20 years), and that of others on late Quaternary environmental changes in southern Chile. Recent work has quantified temperature and precipitation for the past 43,000 yr using regression equations applied to two well-known pollen sites in the Chilean lake district. The equations relate taxa of modern pollen rain to mean January (summer) temperature and annual precipitation. Results imply that climate at these sites during the maximum of the last glaciation were relatively cold and dry; cold and wet conditions also prevailed between 11,000 and 10,000 yr BP 4,950 - 3,160 yr BP, after 3,150 and before 890 yr BP and between 350 yr BP and the present. Making the critical point that South America is a vegetated land mass reaching farthest poleward in the Southern Hemisphere, Heusser also discusses pollen data from Patagonia.

Five of the following chapters (3,4,6,7,11) are based on palaeontological and palynological studies of sites in extra-glacial districts of Argentina and Brazil (chapter 4). In chapter 3 (Toni and Fidalgo) reference is made to remarkable faunal variations in eastern Argentina (Buenos Aires Province) resulting from dramatic climatic changes (arid to more humid) associated with glacial and inter-glacial epochs. Chapter 6 (D'Antoni) illustrates the application of statistical analyses (R-mode Cluster and P-mode Principal Components) to pollen recovered from sediments within a cave called 'Gruta del Indio' in Mendoza Province. Results indicate that the greatest environmental change of the last 30,000 yr occurred about 10,000 yr ago as vegetation surrounding the site changed from a cool-dominated to a temperate-dominated type (coinciding with the disappearance of the giant sloth). A change over of weather systems is inferred, from Pacific Anticyclonic to Atlantic Anticyclonic.

Of the remaining chapters that by Cobos and Boninsegna (5) on glacier fluctuations in Mendoza province is the only one in the book of particular interest to glacial geomorphologists. Using information from travellers' narratives, old scientific reports and drawings and modern ground and air photographs, the authors have mapped past and present positions of glacier snouts in the upper Atuel river basin. They conclude that the glaciers have undergone constant recession in the last 400 years and that one glacier (Laguna glacier) may have had a small surge.

Other chapters deal with radiocarbon measurements made at Museo de La Plata (8), the utility of a glacier inventory in Bolivia (9) and the radiocarbon chronology of a tephra layer at Neuquén (10).

This volume will be of some interest to people working on Quaternary topics in South America and perhaps in the Southern Hemisphere in general. Its greatest value may be in exposing the nature of some of the research currently being done in parts of South America, in encouraging contact between investigators and in stimulating more work in this vast but little-known region. Hopefully, some papers on the Antarctic Peninsula may emerge in a future volume.

References

- Caldenius, C. 1932. Las glaciaciones cuaternarias en la Patagonia y Tierra del Fuego. *Geografiska Annaler* 14, 1-64.
- Evenson, E., Schluchter, Ch. and Rabassa, J. 1983. Tills and related deposits. A.A. Balkema, Rotterdam.

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Tills and related deposits. 1983. Edited by E.B. Evenson, C. Schluchter & J. Rabassa. A.A. Balkema: Rotterdam. 454 pp. £26.50.

This volume represents the latest in a series of publications that have arisen out of the annual meetings of the INQUA Commission on the genesis and lithology of Quaternary deposits. This Commission is dominated by Working Group 1 which is concerned with the genetic classification of till and criteria for its differentiation; hence the title of this book.

Tills and related deposits comprises a collection of 43 papers, most of which were presented at either the North or South American meetings of the Commission which were based in Wyoming and Idaho in 1981, and in Argentina in 1982, respectively. The theme of the contributions includes some natural predominance of topics from these areas. The volume itself is the second produced by this publisher and closely resembles the previous collection *Moraines and Varves*, in having the same camera-ready style, hard-back binding and cover design.

The papers are arranged into various categories. As one would expect the largest section comprises twelve papers that consider aspects of till genesis. This is followed by three concerned with till petrology, three that discuss applied topics, four on glaciofluvial and glaciolacustrine sediments, four on pre-Pleistocene glacial sequences, and twelve, on various topics including non-glacial sediments.

Finally, there are papers relating to field excursions that accompanied the symposia: three from Wyoming and Idaho and two from Argentina.

Since this volume includes writings from a wide range of authors from many parts of the world it is reasonable to expect some unevenness. However, this volume is disappointing from several viewpoints. Firstly, the papers lack consistency of presentation; for example, some have abstracts while others do not. Secondly, the language of papers by non-English speaking authors has in many cases been little or only partially corrected. This makes articles difficult to read. There is even one paper in German. In addition, there are a large number of mistakes due in part to the style of production chosen; for example Holocene is spelt with a small 'h' in the title of one paper. However, the production is generally good and the illustrations are particularly clear.

Notwithstanding these problems it is unclear why this volume was actually produced in this form. The main aim of the Commission's Working Group, the genetic classification of till and differentiation of its facies types, is discussed only in a minority of papers. The remainder range across the whole area of glacial sediments and stratigraphy, including pollen sequences in Bolivia and non- or periglacial accumulations in the Alps. Of the papers that are presented several are interesting and valuable contributions. The majority are, however, progress reports. No linking discussions or introductions to sections are included. Nevertheless, it is particularly refreshing to see so much work from South America presented.

Overall, therefore, it is not clear how this volume greatly advances the aims of the energetic INQUA Commission's work. Perhaps it is time for this body to draw together the strings and present a volume for general consumption in which the criteria and properties of tills are unequivocally reviewed and discussed?

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Downing Street,
Cambridge CB2 3EA,
England.

The Pleistocene by T. Nilsson. 1983. D. Reidel Publishing Company: Dordrecht, Boston and London. 651 pp. Published price £59.50*.

The publication of a text that aims to summarise world evolution during the Pleistocene is a rare event; rarer still when it is as comprehensive and learned a text of the magnitude of Professor Nilsson's work. In this volume the reader is offered a substantial and authoritative survey of Pleistocene events as they are at present understood. The book represents a complete reworking and expansion of Nilsson's 1972 *Pleistocene* textbook (in Swedish), which undoubtedly provided the foundation for the present volume.

* Price to QRA members by special arrangement with the publishers: £34.00 until 31.3.84.

In 23 chapters this book reviews the Pleistocene sequences from predominantly stratigraphical and palaeontological viewpoints. It begins with an introductory section concerned with basic aspects including the development of the glacial theory and a discussion of stratigraphical terminology. This is followed by a review of Cenozoic events that culminated in the Pleistocene and a valuable discussion of the recognition and dating of the Plio-Pleistocene boundary. The next two chapters deal with the basic additional information a broadly-trained geologist would require for considering Quaternary stratigraphical sequences, particularly those in mid to high latitudes. These include a short review of glacial and periglacial processes and sediments, together with a consideration of the various dating methods available to Quaternary scientists.

Since the author argues, events in Europe are fundamental to our understanding of Pleistocene history, they are given the main emphasis; all other sequences in the book being correlated with those in North-West Europe. As a result there are detailed descriptions of the Alps, the type area of Italy, the British Isles and the Lower Rhine region. These are followed by a broader description of the European continent as a whole; the Last Glaciation being treated in a separate chapter. Next there follow a series of useful chapters in which the evolution of Asia, Africa, Australasia, Antarctica, South America and North America (including Greenland) are presented. In particular the latter is singled-out for consideration because of its importance on a global scale. A single chapter summarises the oceanic record.

Subsequent chapters present systematic reviews of the animal and plant kingdoms, to provide non-biologists with a basic understanding of the implications of the Pleistocene sequences described in the book. These are accompanied by a survey of human cultural stages. The problems of initiation and control of climatic oscillations are considered in the final chapter. There are, in addition, four appendices dealing with the Holocene, not mentioned elsewhere in the discussions; stratigraphical terminology; the biogeographical subdivision of the Earth and the classification of vascular plants.

The book is completed by an up-to-date, comprehensive and very impressive 120 page bibliography.

The great strength of this volume is that it provides an invaluable summary of sequences both within Europe and beyond. This is especially true of areas for which almost all the literature is in local languages. Moreover, it is very useful to have in one volume details of the African, Asian, Australasian, Italian, Eastern European and South American sequences from stratigraphical and palaeontological viewpoints. It is also refreshing to see the incorporation of reviews of the relevant human fossil and cultural stages, in the regional chapters. This underlines the inseparable connection between Pleistocene Geology, Palaeolithic Archaeology and Physical Anthropology. In addition, fossil assemblages and mammalian sequences in particular, are well described and their palaeoenvironmental and palaeoclimatic significance discussed. There is however some unevenness in the coverage of different fossil groups.

As will be appreciated this book is a major work by any standards and follows in direct line of inheritance from the great Pleistocene textbooks such as Geikie, Wright, Zeuner, Charlesworth, Woldstedt and Flint. It is clear that Professor Nilsson greatly admires the work of the latter two authors since their names recur throughout the book and indeed it is dedicated to their memory. One cannot help wondering, however, whether it will be possible in the future for one person to undertake such a broad survey, particularly in view of the rapid expansion and specialisation of Pleistocene research. Perhaps this book will be the last of its type?

Probably because the book is based upon these earlier texts, one is struck when reading it by its traditional approach to Pleistocene history, in that the author presents the story from a North-West European, northern hemisphere aspect. Whilst there is nothing wrong with this in view of the extremely detailed sequence known in Europe, apart from purely historical reasons, it might be interesting to see the world presented from other points of view, for example from tropical or even southern hemisphere perspectives. Even within the context, the author's approach is a little 'old-fashioned' in that he gives detailed explanations of major end-moraine systems and terrace sequences, rather than describing the newer results of lithostratigraphy which are rapidly replacing the older morphostratigraphies of Northern Europe and North America. In these matters it is particularly unfortunate that Professor Nilsson has chosen to refer to glacial and interglacial stages using out-dated terminology e.g. Weichsel Glaciation instead of Weichselian Stage and Holstein Interglacial instead of Holsteinian Stage etc. He explains this by quoting Flint, who thought it 'unnecessary and cumbersome' to use the adjectival forms, since they are used to denote chronostratigraphical units rather than names for major glacial or non-glacial events. The latter approach is, of course, based on the recognition of continental glaciation and not on time stratigraphy. Since these stages must have also occurred outside the glaciated regions it is however, sidestepping the issue to adopt the authors approach. It is clearly necessary to adopt a nomenclature that allows time rather than individual glacial or non-glacial events to be named, since such events may represent only a short period within any given stage. It is therefore a little pedantic to follow the older usage. To be fair, the difference may be less obvious to non-native English speakers such as Nilsson himself, because of translation problems. Nevertheless his plea for the geological treatment of Pleistocene successions, whilst being recognised as a special case, cannot be helped by determinedly adopting this line.

Having said this, there are no doubt many who will want this important work and indeed no serious student of the Pleistocene will wish to be without it. Professor Nilsson may justifiably be proud of this impressive and beautifully produced book.

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Publications received

A History of Naturalists in North East England edited by A.G. Lunn 1983 published by The Department of Adult Education, University of Newcastle upon Tyne. ISBN 0 950898201 price £2.00 plus £0.33 for postage.

This volume of 112 pages is a publication of a series of lectures given in 1979 at Newcastle, to mark the 150th anniversary of the Natural History Society of Northumbria. The volume ranges widely over most aspects of natural history with chapters on botanists, entomologists, marine biologists and ornithologists. The major interest to Q.R.A. members will be contained in the chapters on geologists (by D.A. Robson) and on physical geographers, Quaternary geologists and conservationists (by A.G. Lunn). Both of these chapters contains a rapid run-through of the major figures associated with the North East of England and their main ideas since about 1800. As such this volume is a useful source for both biographical details and as an introduction to contributions of scientists who have worked in this area throughout the last two centuries.

Studies in Speleology vol. IV edited by G.P. Black and R.G. Cooper 1983. Published by The William Pengelly Cave Studies Trust Limited. Obtainable from the Trust c/o 107, Andover Road, Newbury, Berkshire price £8.00 (£12.00 to institutional subscribers).

Q.R.A. members will be familiar with the Journal *Studies in Speleology* which has appeared at intervals since 1964. The special number volume IV marks a change in the form of production of the journal so that it will now appear annually, and as well as the descriptive papers and reports previously published, will now contain at least one major review of some aspect of cave science per volume.

Volume IV of *Studies in Speleology* shows this new pattern well. The major review on Pleistocene bone caves in Britain and Ireland by A.J. Stuart occupies 28 pages and the remaining seven shorter papers 57 pages together. For Q.R.A. members the major interest will be the paper by Stuart which is a detailed summary, with maps and sections, of the known bone caves of Britain and Ireland. In the editor's preface we are promised more reviews of this type, and vol.5 is hoped to contain a similar wide ranging global review on speleothems by Dr. M. Gascoygne. The shorter papers cover a breadth of interests which may only be peripheral to the mainstream of Quaternary Research, but which will undoubtedly be of real interest to individual Q.R.A. members. Papers in vol. IV include ones on Mass Movement Caves in Great Britain (by R.G. Cooper) and The Excavation of Upper Kendrick's Cave, Llandudno (by M. Davies), which may have distinct interest to students of the Quaternary, while others such as those on Horseshoe Bats in Devon Caves (by J.H.D. Hooper) and The Caves of Fairy Cave Quarry (by G. Price) may be of less immediate concern.

As a whole, the journal promises to be a useful addition to the pre-existing literature in Quaternary Studies especially if it can continue to publish long reviews of topics of concern to Q.R.A. members.

Quaternary Science Reviews

In *Quaternary Newsletter* 38 the subscription price of *Quaternary Science Reviews* was noted as £32.14. This is, in fact, the institutional subscription. The current individual subscription is £15.00. Volume 2 part 1 of *Quaternary Science Reviews* is now published and contains papers by K.W. Butzer (Global Sea Level Stratigraphy: An Appraisal) by S. Howe and T. Webb III (Calibrating Pollen Data in Climatic Terms: Improving the Methods), and by J.A. Tyldesley and P.G. Bahn (Use of Plants in the European Palaeolithic: A Review of the Evidence). *Quaternary Science Reviews* may be obtained from the publishers, Pergamon Press, Headington Hill Hall, Oxford OX3 0BW.

Loess Letter

Loess Letter is published by the Quaternary Research Group of the University of Waterloo; it is the informal newsletter of the INQUA Loess Commission. LL appears twice a year, usually around April and October. Requests for copies, and material for publication should be sent to Prof. Ian Smalley, Department of Earth Sciences, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1. Brief research papers are published, also reviews of recently published material, and news items and announcements.

LL10 features SEM and loess, some newly discovered loess in Washington State (very close to the Canadian border, there must be related deposits up in British Columbia), loess in Siberia, and a type-sequence at Achenheim; loess in Britain in its periglacial context, redeposited loess with Israel and dust-rain in China. LL11 (elelelelele) is due to be a special issue for the 1984 International Geological Congress in Moscow (IGC 27, 4-14 August).

Permafrost: Fourth International Conference, Proceedings is now available for \$65.00 (U.S.) prepaid from the National Academy Press, 2101 Constitution Avenue, N.W., Washington, D.C. 20418. The 1524-page volume contains 276 papers covering a wide range of engineering and scientific topics. These include roads, embankments, airfields, excavations, frost heave, ground ice, hydrology, ecology mapping, planetary permafrost, remote sensing, periglacial features, soil mechanics, pipelines, piles, terrestrial and subsea permafrost and others. The volume was produced in conjunction with the Conference, which was held in Fairbanks, Alaska, in July 1983.

NOTICES

Colloque mouvements de terrain - a Colloquium on ground movements
22nd - 24th March 1984 to be held at the Université de Caen, Esplanade de la Paix 14032 Caen.

The meeting will consist of two days of paper sessions on aspects of ground movements and a third day of field trips to the Normandy Coast. Further details from:

Centre de Recherches en Géographie Physique de l'Environnement,
Colloque "Mouvements de terrains", Université de Caen,
Esplanade de la Paix, 14032 Caen Ciedex, France.

American Quaternary Association

Eighth Biennial Meeting: August 13-15, 1984 - Boulder, Colorado.

With 1-day and 2-day field trips before and after the meeting.

Theme of the meeting: Seasonal climatic responses in the Quaternary.

Inquiries: AMQUA
Office of Conference Services
Campus Box 153
University of Colorado
Boulder, Colorado 80310
(303) 492-5151

INQUA - Subcommission for the Study of the Holocene, North America and Greenland

1st Symposium on Holocene climates and trends in North America and Greenland, Université de Sherbrooke, Québec, 3rd October 1984.

The Symposium will be held before the 5th Congress of AQQUA (Association québécoise pour l'étude du Quaternaire) which will take place on October 4 - 7, 1984, in Sherbrooke. The theme of the congress is: "Pleistocene and Holocene Stratigraphy and Palaeoenvironments of Québec and Adjacent Regions".

The Symposium is the first one organized by the new executive of the Subcommission elected in August 1982 in Moscow. The theme of the symposium is the new research focus of the Subcommission.

The main objectives of the symposium are to present:

- new global syntheses for the pre-historic period;
- new techniques and methodologies applied to any region of North America and Greenland (including Mexico);
- other original contributions on other regions.

This is a multidisciplinary symposium, thus papers concerned with Holocene climates from any disciplines are invited.

A special issue of "Géographie physique et Quaternaire" is being planned to publish papers or notes accepted by the Journal.

The registration fees to the Symposium will be around 10,00S (5,00S for students) and the registration to the AQQUA congress will be around 35,00S (15,00S for students). A special price for the two events might be considered.

A second circular with the preliminary program will be prepared at the end of 1983.

For further information on the Symposium:

- the secretary of the Subcommission,

Jean-Marie M. Dubois
Département de géographie
Université de Sherbrooke
Sherbrooke (Québec)
J1K 2R1
Tel.: (819) 565-4566/4521

- the president of the Subcommission,

Thompson Webb III
Department of Geological Sciences
Brown University
Providence, Rhode Island
02912 USA
Tel.: (401) 863-3221

For information on the AQQUA congress

Hugh Gwyn
Département de géographie
Université de Sherbrooke
Sherbrooke (Québec)
J1K 2R1
Tel.: (819) 565-4695
565-4521

INQUA - Subcommission on shorelines of Northwestern Europe

Field meeting North sea coastal zone between Jade Bay and Jammer Bight

Preliminary Programme

- | | |
|------------------------|--|
| Saturday, September 15 | Assemble in Bremen at the Bodentechnologisches Institut, Friedrich-Mißler-Straße 46/48.
which is a branch of the Geological Survey of Lower Saxony, Hannover. |
| Sunday, September 16 | Travel by bus: Sehestedter Außendeichsmoor, Jade Bay - Weser estuary - Sahlenburg near Cuxhaven - Bederkesa.

Holocene development of Jade Bay and the Weser estuary, transgression phases, human settlements in the coastal zone. |

- Monday, September 17 Bederkesa region - Elbe, ferry to Gluckstadt - Dithmarschen and Eiderstedt region in Schleswig-Holstein. Overnight at Husum.
- History of human settlements, paleolimnological development of marsh lakes, marine ingressions of the Holocene. Sandy Holocene and coastal barrier systems in southwestern Schleswig-Holstein.
- Tuesday, September 18 Husum - North Frisian tidal flats - Denmark. Overnight at Varde.
- Halligen Islands, remnants of former marsh and relics of human settlements and agriculture in the present tidal flats.
- Sedimentation and landscape development since medieval storm surges.
- Wednesday, September 19 Varde - Nymindesgab - Holmsland Klit - Ringkøbing - Harboøre - Tejbyboron/Agger (ferry) - Thisted-Klim. Overnight at Klim near Fjerritslev.
- Holocene development of the Ringkøbing Fjord lagoon and the beach barrier Holmsland Klit, Harboøre/Agger isthmus between the North sea and the Limfjorden, marine Holocene near Vester Hanherred.
- Thursday, September 20 Symposium at Klim. Overnight at Klim.
- Friday, September 21 Klim - Lokken - Lønstrup - Tvaersted - Sindal - Hjørring - Ålborg. End of the excursion in Ålborg.
- Cliff in Holocene marine gyttjaneer Lokken, Holocene beach and cliff in Late Weichselian marine sand (Saxicava sand) near Lønstrup, various localities with Late Weichselian marine shell bearing deposits.

Departure from Ålborg by air, train or bus back to Bremen.

Organiser, from whom further details may be obtained:

Dr. H. Streif,
Niedersächsisches Landesamt für Bodenforschung,
Stilleweg 2,
D-3000 Hannover 51,
West Germany.

International Geographical Union Commission on
the Significance of Periglacial Phenomenon

Quaternary Research Association Conference and Field Excursion
Periglacial Processes and Landforms in the British Isles 21st-23rd
September 1985

This meeting will consist of a 1½ day paper session in Manchester following on from the First International Conference on Geomorphology.

It is intended that half a day be devoted to about 6 speakers from overseas presenting papers on topics relevant to periglacial studies in the British Isles. A full day session with 10-12 speakers will consider the current state of periglacial studies in these islands. On the final day a field excursion is planned, probably to the Lake District and northern Pennines.

Professor Hugh French (IGU, Periglacial Commission) is responsible for organising the overseas contributions. Dr. John Boardman (QRA, Executive Committee) is responsible for the British contributions and the field excursion.

It is hoped that many participants in the International Conference on Geomorphology will remain in Manchester for the periglacial conference. The conference papers will be published. I am at present attempting to assemble a complete list of people working on periglacial topics in the British Isles and would be grateful for any information.

John Boardman
Local Secretary,
Brighton Polytechnic,
Falmer, Brighton.

One Day Symposium on Tree Rings - City of London Polytechnic, 11 May 1984

A one day symposium covering several aspects of tree ring studies will be held on Friday, 11th May 1984, at Navigation House (next to Tower Hill tube station), City of London Polytechnic. The provisional programme covers the following broad topics:-

Tree Rings and ecology (3 papers)
Wood anatomy (3 papers)
Dendrochronology (3 papers)
Miscellaneous (approx. 3 papers).

Anyone interested in attending or obtaining further details should contact:

Dr. R.G.W. Ward
Geography Department
City of London Polytechnic
Calcutta House
Old Castle Street
London E1 7NT

There will be a registration fee of £6.00, which includes lunch, morning coffee and afternoon tea.

University of Leicester : Department of Adult Education

Icelandic landscapes - a day lecture course on Icelandic geology and geomorphology given by M.D. Jones on Saturday 17th March 1984. Further details and also details of Study Tours to Iceland, Spanish Pyrenees, High Atlas and Sierra Nevada, from: Ms. Eileen Sunderland, University of Leicester, Department of Adult Education, Vaughan College, St. Nicholas Circle, Leicester LE1 4LB.

Pontnewydd Cave - A Lower Palaeolithic Hominid Site in Wales
The First Report - edited by H. Stephen Green

Pontnewydd Cave is producing Middle Pleistocene hominid remains in association with a late Acheulian industry. This First Report of excavations by the National Museum of Wales includes important accounts of the archaeological and hominid finds, U-series and TL dating, fauna, geology, geomorphology and sedimentology.

Contributors: Aitken, Bevins, Bull, Clayton, Colcutt, Currant, Debenham, Embleton, Huxtable, Ivanovich, Jenkins, Molleson, Newcomer, Schwarcz, Stringer.

Publication date: 31 March 1984.

Hardback approx 208 pages/39 plates/71 figs./ ISBN 0 7200 0282 6

Pre-publication price: £15.95/US \$32; thereafter £19.95/US \$40

Obtainable from: Alan Sutton Publishing Ltd., 17a Brunswick Road, Gloucester GL1 1HG, UK.

Sixth International Palynological Conference, Calgary 1984
 August 26 - September 1

Would anyone wishing to take part in group travel (to reduce costs and administration) to the above conference please contact: David J. Maguire, Department of Geography, University of Lancaster, Bailrigg, Lancaster, LA1 4YR Tel. (0524) 65201 Ext. 4960.

150th Anniversary of Glacial Theory, 1986
Preliminary Notice and Call for Papers

To mark the beginning of the 150th anniversary year of the Glacial Theory, the QRA is planning a major symposium on the History of Quaternary Research, to be held in London from 6-8 January 1986.

Further details will follow in due course, but at this stage we are anxious to have preliminary offers of papers for the symposium in any related field, including, for example:

1. Origins of the Glacial Theory.
2. Biographical studies of pioneers in Quaternary studies.
3. History of research methods and techniques.
4. Historical reviews of the study of Quaternary flora, fauna, geomorphology, archaeology, etc.
5. History of Quaternary studies within particular geographical regions.

In addition to those with established interests in the history of science, it is likely that QRA members in all fields may well have valuable historical material which they have worked on in the course of their contemporary scientific work but which has not so far fitted conveniently into their published research. This symposium would therefore offer an excellent opportunity to present such historical material.

It is planned to produce a substantial volume on the History of Quaternary Research in conjunction with an appropriate leading publisher, based on the papers presented to the symposium.

Offers of papers must be accompanied by an abstract or an outline of the work in progress of at least 200 words, and should be sent to the co-ordinator of the symposium: Patrick J. Boylan, Director of Museums and Art Galleries, 96 New Walk, Leicester LE1 6TD, England.

Closing date for receipt of offers of papers: 31 December 1984.

CALENDAR OF MEETINGS

- | | |
|--------------------------------------|--|
| 24th March
1984 | Quaternary Research Association 20th Anniversary Dinner at St. John's College, Cambridge. A booking form is issued with this Newsletter. |
| 14th-17th
April 1984 | Quaternary Research Association Annual Field Meeting in West Wales, based at Carmarthen. Organiser Prof. D.Q. Bowen. Further details and a booking form are issued with this Newsletter. |
| 4th - 8th
May 1984 | Quaternary Research Association Short Field Meeting in Mull. Organisers Dr. J.J. Lowe and Dr. M.J.C. Walker. Further details and booking forms will be issued with this Newsletter. |
| 11th May
1984 | Geophysical Section of The Royal Astronomical Society: Physical methods of dating in the Quaternary. Meeting to be held at the Geological Society Lecture Theatre, Burlington House. Organiser, Dr. A.G. Wintle. Further details in the Circular with this Newsletter. |
| 11th May
1984 | Symposium on Tree Rings, City of London Polytechnic. Organiser Dr. R.G.W. Ward. Further details on p.49 of this Newsletter. |
| 25th May
1984 | William Smith Lecture, Geological Society, Burlington House. For further details see the Circular with this Newsletter. |
| 13th-15th
August 1984 | 8th Biennial meeting of AMQUA Boulder, Colorado. Further details on p.46 of this Newsletter. |
| 31st August
2nd September
1984 | QRA short field meeting in Buchan, north-east Scotland. Organised by Dr. M. Hall. For further details see the Circular with this Newsletter. |
| 9th - 14th
September 1984 | British Association for the Advancement of Science, Norwich. Further details with this Newsletter. |
| 15th-21st
September
1984 | INQUA - Subcommission on Shorelines of north-western Europe - Field meeting in West Germany and Denmark. Further details on p.47 of this Newsletter. |
| 24th-27th
September
1984 | QRA Study course on pollen analysis, Botany School, Cambridge organised by Prof. R.G. West. Further details in the Circular with this Newsletter. |
| 3rd - 7th
October 1984 | INQUA Holocene and AQQUA Meeting University of Sherbrooke, Quebec. For further details see p.46 of this Newsletter. |

QUATERNARY NEWSLETTER

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