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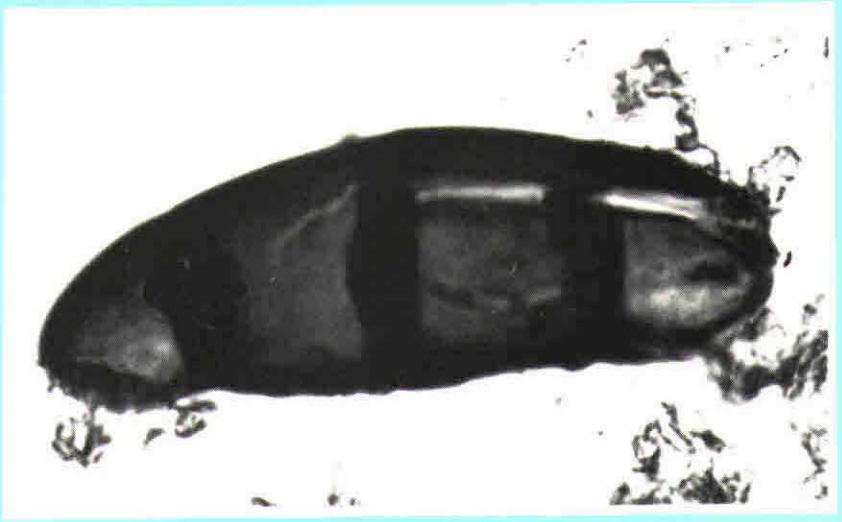

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QUATERNARY NEWSLETTER

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COVER PHOTOGRAPH:
Triseptate, inaperturate fungal spore resembling that of the fungus *Meliola niessleana*. Size range of spore population 37 x 14μm to 47 x 15μm. Recovered from stratified underwater deposits of heather, straw and dung from Dun Bharabhat, Isle of Lewis. Sample provided by the Scottish Trust for Underwater Archaeology (STUA), photomicrograph taken by C.M. Clarke.
See abstract by Ciara Clarke in this issue.

ARTICLE

WAS NORTH-WEST LEWIS GLACIATED DURING THE LATE DEVENSIAN?

A. M. Hall

Introduction

Recent reconstructions of ice extent at the maximum of the Late Devensian glaciation show an ice limit near the coast of north-west Lewis (Peacock, 1984; Sutherland and Walker, 1984; Stoker *et al.*, 1993). This ice limit is based on a supposed drift limit. A raised beach, the Galson Beach, is apparently not covered by *in situ* glacial deposits beyond the drift limit yet overlain by Late Devensian till in areas to the north, south and east (Peacock, 1981, 1984, 1991; Sutherland and Walker, 1984). This note describes evidence that thin diamicts which overlie the Galson Beach, previously interpreted as solifluction deposits (Peacock, 1984; Sutherland and Walker, 1984), are largely *in situ* glacial deposits. It is highly likely that all of north-west Lewis was covered by ice in the Late Devensian and that the maximum ice limit during this episode lay well to the west on the Hebridean Shelf.

Local stratigraphy

The critical area lies between Melbost Borve and Toa Dibadale (Figure 1). This is the only area regarded as unglaciated in the Late Devensian by both Peacock (1984) and Sutherland and Walker (1984). A raised marine rock platform at 7-10 m OD is overlain by a complex sequence of deposits (Gordon, 1993). At several locations, the platform is overlain by till (von Weymarn, 1974; Peacock, 1984). At Toa Galson (Figure 1), an organic deposit interbedded with sand occurs above the rock platform and is overlain by periglacial slope deposits and raised beach gravels . The organic deposit has given radiocarbon ages of >39.1 and >47.2 ka. Pollen spectra indicate the development of treeless grassland and heathland vegetation under interglacial or interstadial environments (Sutherland and Walker, 1984). Overlying these deposits, but usually resting directly on the marine shore platform, is the Galson Beach, a dominantly pebbly raised beach with an upper surface between 10 and 14 m OD. The Galson Beach is an impressive feature, up to 200 m wide and with up to 5 m of gravel at South Galson, and can be traced more less continuously along the 5 km of coastline between Breivig and Toa Dibadale (Figure 1). It consists

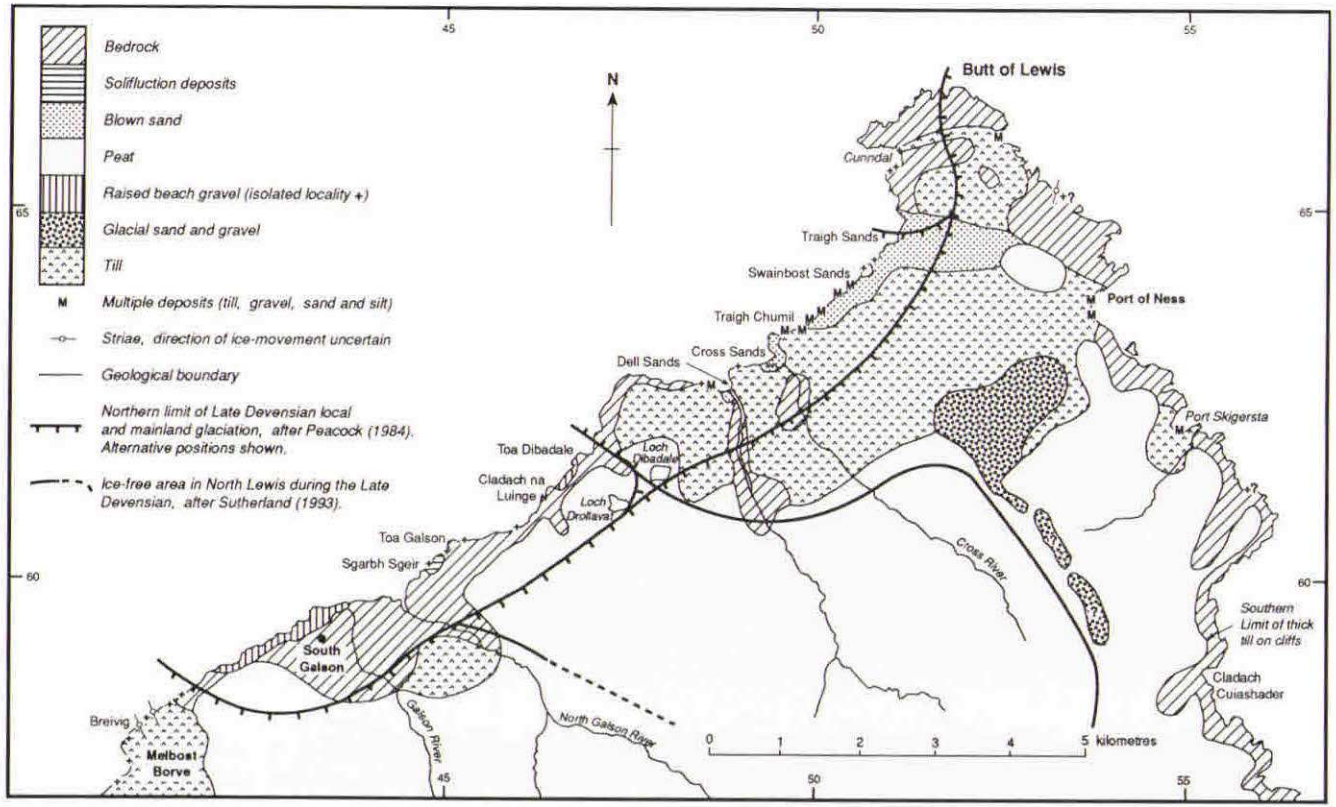

Figure 1. Late Quaternary deposits and proposed ice limits in northern Lewis. Adapted from Peacock (1984).

mainly of rounded, clast-supported gravel, either openwork or with a sand matrix, and often with sub-horizontal bedding. Boulder lags are present resting on bedrock and locally the beach includes lenses and beds of coarse sand. Clasts are mainly of Lewisian gneiss but red-brown sandstones are present (Peacock, 1984). Between Breivig and Toa Dibadale, gravel-rich and silty sandy pebbly diamicts overlie the beach at many locations and have been interpreted as solifluction deposits reworked from the Galson Beach and from tills older than the Galson Beach. *In situ* glacial deposits overlying the Galson Beach were not recognised along this stretch of coast which is regarded as unglaciated since beach formation (Peacock, 1984; Sutherland and Walker, 1984). At Breivig, the Galson Beach is overlain by till and the raised rock platform has been striated by ice moving to the NNW (Peacock, 1984). To the south, traces of beach gravel become less frequent and, beyond a locality (NB 372544) near Ballantrushal, the raised beach has been entirely removed by glacial erosion (Peacock, 1984). Breivig therefore has been taken as the southern limit of the unglaciated area (Gordon, 1993). To the north of Toa Dibadale, isolated occurrences of rounded gravels which probably belong to the Galson Beach occur beneath or possibly reworked into thick sequences of interbedded diamicts, gravel, sand and mud (von Weymarn, 1974; Peacock, 1984; Sutherland and Walker, 1984). Shells from these multiple deposits have given radiocarbon ages of around 34.5 and 39.5 ka (Sutherland and Walker, 1984) and amino acid ratios consistent with Early and Middle Devensian ages (Sutherland, unpublished, cited in Gordon, 1993) suggesting that these deposits are of Late Devensian age. The glacial deposits overlying the raised beach south of Breivig are not dated but are also reasonably regarded as belonging to the last, Late Devensian glaciation (von Weymarn, 1974; Peacock, 1984; Sutherland & Walker, 1984). These indicate that the Galson Beach predates the Late Devensian. The remnants of the Galson Beach which underlie glacial deposits south of Breivig and north of Toa Dibadale can be inferred to predate the Late Devensian (von Weymarn, 1974; Peacock, 1984; Sutherland and Walker, 1984; Gordon, 1993).

Between Breivig and Toa Dibadale, the Galson Beach is overlain by diamictons, from 0.2 to 3 m thick and cryoturbated to a depth of up to 2 m. Diamicton lithology reflects the amount of reworking of the subjacent beach gravels. At a few localities, the diamict is almost entirely composed of rounded pebbles, with or without a sand matrix, and is distinguished from *in situ* beach only by the absence of bedding and the presence of erected pebbles. More usually, these gravel-rich diamicts show clasts supported in a matrix of grey to brown sandy silt or sand, intercalation of thin beds and lenses of grey to brown diamicton and the inclusion of a few sub-angular blocks of Lewisian gneiss. As the amount of incorporated beach material declines and the number of rounded clasts

diminishes, the deposit becomes a grey to grey brown, generally massive, matrix-supported, sandy diamicton. Where the diamicton is uncontaminated by beach gravel, its clasts consist entirely of subangular to subrounded Lewisian gneiss.

These diamictons are unlikely to be products of the solifluction of diamicton older than the Galson Beach across its surface. The reasons for this interpretation are:

A. Whilst the patches of till below the Galson Beach contain red-brown sandstones, the diamictons which overlie the beach do not (Peacock, 1984), except where beach material has been incorporated. This simple lithological distinction means that the near-surface diamicts cannot simply be a result of solifluction of older tills.

B. Solifluction of older diamictons onto the Galson Beach requires a source for this material. Thin diamictons are present below *in situ* beach gravels at only a few, widely-scattered localities (Gordon, 1993). Diamictons may have overlain the backing cliff of the Galson Beach prior to the Late Devensian but solifluction from this source requires mass movement across the gentle and permeable surface of the raised beach. It is therefore often difficult to identify a source of pre-Late Devensian diamicton for later solifluction. Where (as at NB 417584) the backing cliff of the raised beach approaches the present shoreline, a tripartite sequence is seen, with the Galson Beach and diamicton capped by a blocky breccia, up to 2 m thick, derived from shattering and solifluction of Lewisian gneiss. These breccias post-date deposition of the diamictons and probably formed towards the close of the Late Devensian.

C. Some gravel-rich facies of the diamicton are structureless, openwork pebble and granule gravels (*eg* at NB 455604). It is difficult to see how these matrix-free gravels could be moved by solifluction. Furthermore, the widespread development of erected pebbles in the upper 2 m of the diamicts is evidence of cryoturbation operating at essentially flat sites rather than solifluction carrying material across slopes.

The diamictons are interpreted here as products of glacier ice moving over the surface of the Galson Beach, with later periglacial disturbance. The reasons for this interpretation are:

A. South of Breivig, grey to grey-brown sandy diamictons occur which are interpreted as lodgement till (Peacock, 1984). Diamictons of similar lithology can be traced as thin layers or lenses interbedded with gravel diamictons along the entire length of the coast between Breivig and Toa Dibadale. Locally, these diamictons thicken, as near Cladach na Luinge (NB 464607), where grey sandy

diamicton is up to 2 m thick, and at South Galson (NB 432593), just 250 m SW of where the Galson Beach reaches its maximum thickness, where grey-brown silty diamicton is up to 3 m thick. Elsewhere, discrete masses of grey to brown diamicton may be absent from the gravel diamictons overlying the Galson Beach. Gravel-rich, clast- and matrix-supported facies of the diamicton may contain, however, varying proportions of grey to brown silty sand matrix (*eg* west of Toa Galson at NB 449601 and near South Galson at NB 4365959) which is not present in the *in situ* beach gravel but which is similar to the matrix of the tills south of Breivig and at the localities mentioned above.

B. These gravel diamictons may contain isolated large, subangular blocks of Lewisian gneiss (*eg* at NB 426590).

C. Stacked beds (0.4-1.6 m thick) of structureless gravel occur within the diamicton. In places (*eg* at NB 433593 and NB 448601), these gravel beds are separated by thin (about 10 cm) layers of silty sandy diamict. Along the coast immediately to the SW of these localities, the Galson Beach is thin or found only in patches. The stacked gravel beds appear to represent local transport of beach gravels as glacial rafts. The stacked sequences of diamict and gravel at Cunndal (Peacock, 1984) may be of similar origin.

D. The distribution of remnants of the Galson Beach and the character of the overlying diamicts reflects the subtle influence of topography over patterns of glacial erosion. At Breivig, ice flow was to NNW (Peacock, 1984). North of Breivig, where the Galson Beach is not backed by high ground to the S or SW it is eroded out and its former presence is only attested to by the presence of rounded clasts in the diamictons resting on the raised rock platform. At North Galson, the beach is preserved in the lee of SW-NE trending roches moutonnées. North and south of Toa Galson, the beach tends to present only at the back of former geos and absent or reworked on adjacent exposed parts of the raised rock platform. This selective preservation, it is argued, is a result of glacial, rather than periglacial processes.

Apart from the presence of glacial deposits, there are other reasons for doubting the existence of an ice-free area along the coast of Lewis between Breivig and Toa Dibadale during the Late Devensian. The supposed ice-free area is small, about 5 km in length, and generally extending only 1-2 km inland and overlooked by higher ground. It seems unlikely that ice capable of the striation of bedrock at Breivig and depositing till here and around Galson Lodge (NB 455591) (Peacock 1984) would not also have invaded the low-lying coastal strip. Moreover, there are no ice-marginal landforms identified along the edge of this apparent ice-free area. It is therefore very probable that all of north-west Lewis was glaciated in the Late Devensian.

Discussion

The lithology and distribution of the diamictons which overlie the Galson Beach indicate a glacial origin. Consequently, there is no drift limit along the coast of north-west Lewis. Instead, rocky terrain with a widespread cover of till gives way, along the coastline occupied by the Galson Beach, to terrain where subtle glacial action has produced limited erosion and disturbance of the Galson Beach and deposition of thin diamictons. These diamictons are not dated but are contiguous with tills south of Breivig which are regarded as Late Devensian in age.

The survival of extensive remnants of the Galson Beach despite Late Devensian glaciation is probably a result of a combination of factors. First, the Galson Beach is found close to the junction between glacial deposits from local Lewis ice and from ice moving out of the Minch across the northern tip of Lewis, and this interlobate location will have favoured its preservation. Second, the raised beach and the rock platform on which it rests have been protected to some extent from the action of ice moving to between N and W by the backing cliff-line. Patches and pockets of beach gravels are also preserved in lee sites and the rock clefts of former geos. Finally, the highly permeable nature of the gravels will have tended to draw water from the glacier base and so restrict sliding and erosion.

The evidence presented here indicates that the whole of north-west Lewis was glaciated in the Late Devensian. This has important implications for reconstructions of the last Scottish ice sheet. Recent work on the Hebrides Shelf indicates the presence of Outer Hebrides and Scottish ice there during the Late Devensian. Morainal banks marking the maximum limit of the Late Devensian ice sheet occur south of St. Kilda (Peacock et al.,1992) and a contemporaneous ice cover has been proposed for the Flannan Isles (Selby 1989) and for the area south of Sula Sgeir and Rona (Stoker et al., 1993). A Late Devensian ice cover in north-west Lewis is consistent with the existence of a maximum limit well to the west of the Outer Hebrides.

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ERRATUM

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Boulder trains as indicators of former ice flow in Assynt, S.W. Scotland by T. Lawson

Page 16, line 1 below Fig. 2 caption, sentence starting '1968' should read "However, it has been noted elsewhere (*eg* Auden 1954; Sissons, 1967; Niini, 1968) that the orientation of glacial rock basins is strongly influenced by lines of geological weakness."

REPORTS

QRA ANNUAL DISCUSSION MEETING (HELD JOINTLY WITH THE MARINE STUDIES GROUP OF THE GEOLOGICAL SOCIETY AND THE NORTH ATLANTIC SEABOARD PROJECT OF IGCP-253) 'THE LATEGLACIAL PALAEOCEANOGRAPHY OF THE NORTH ATLANTIC MARGINS' THE ROYAL SOCIETY OF EDINBURGH 5th-7th January 1995

At a short but respectful distance from Hogmanay, The University and the Royal Society of Edinburgh ushered in 1995 by providing yet another opportunity to keep up with some of the exciting developments in Quaternary science. Following the publication in 1994 of syntheses on the *terrestrial* records of the North Atlantic Seaboard during the last glacial-interglacial transition, this meeting of IGCP-253, Termination of the Pleistocene, focused on *marine* events and the processes, and so was appropriately co-sponsored by the Marine Studies Group of the Geological Society, as well as the QRA. Two days of input via 35 lectures and 22 poster exhibits at the RSE were followed on the 7th January by workshops and discussions at the Grant Institute. The organising committee of **Andrews, Austin** and **Bergsten** can be proud of the vibrant international meeting that they nurtured and **Bill Austin** as local secretary deserves particular appreciation for his obvious hard work during as well as before the event.

The lecture format provided for a mixture of twenty minute talks and somewhat longer review lectures with adequate time being found for immediate discussions after the lectures, an opportunity invariably taken up from the floor. An enormous amount of data was presented, some expanding on recent publications, much of it new, and attendees will hope that a substantial portion will find its way into a planned Geological Society Special Publication, for which they can obtain an advance discount.

Before turning to the scientific issues, consider the effectiveness of the methods of scientific communication. Participants obtained an abstract volume that is probably of a standard typical for such a meeting, yet what opportunities for effective communication were missed! (Indeed several keynote talks were not accompanied by an abstract at all.) No authors offered diagrams in their abstracts, yet many of the oral presentations consisted of talking around figures

whose captions must have been illegible for most of the audience. Rather than singling out miscreants, we should mention **Jeremy Lloyd's** visual aids as both effective and informative. Another specific cause of confusion is the casual use of ages as ka BP in abstracts, usually referring to a ^{14}C age, presumably with a standard correction for the marine reservoir effect. At the meeting itself, it was just as common to hear speakers refer to calibrated ages, and there was specific criticism of the currently accepted calibration of ages as well as demonstrations of the variability of the marine reservoir effect. The research community have got to get a grip on this in future to reduce the incidence of wailing and gnashing of teeth amongst their readers. There were also no formal opportunities to discuss posters with their presenters, which tended to relegate these presentations to sideshows, and so, as in a fairground, one paid more attention to those where loud and excited discourse from the proprietor could be heard, or which featured video images of rotating X-rayed core, or both. The projectors behaved perfectly, yet I could have sworn they were only human too.

Although the meeting focused on data derived from ocean cores in the Lateglacial time interval, there were a number of useful contributions which looked at older events within the last glaciation. Also there were highly pertinent studies of terrestrial sites aimed towards clarifying the timing and speed of climatic change, as well as various presentations on topics more peripheral to the main thrust of the conference. There were many papers focusing on primary core data which set a high standard in terms of use of multiparameter data sets and availability of AMS ^{14}C dates. In comparison with other fields it is delightful to see such a close integration of palaeontological, geochemical and sedimentological approaches and an awareness of the importance of each. Nevertheless, one could baulk at the casual ease with which wiggles in cores were apparently matched in comparison with the care with which statistical evaluation of other parameters were made. The flavour of the meeting can be judged by the following selection of highlights.

The now infamous Heinrich events of ice-rafting of debris across the North Atlantic featured in several contributions. Both **Andrews & Jennings** and **Jennings & Tedesco discussed events in the Labrador sea through which the** carbonate-bearing ice must have passed and are able to pin down strongly varying contributions of Cumberland Sound ice to the record through provenance studies. It still isn't clear whether the ice stream collapsed in the fjord in response to an externally forced climatic change or whether the ice stream extended across the shelf and thus provided a more active influence on climate. **Robinson *et al.*** demonstrated the excellent correlation of magnetic susceptibility with ice-rafted debris abundance in cores across the North Atlantic and emphasised the need for petrographic work to tie down sources and ultimate

origins. **Andrews** believes that all margins of the Laurentide ice sheet would have acted simultaneously on the basis of a 5-10m sea level change associated with the events. However **Thiede**, as part of a general review, described results from the Norwegian Sea indicating a series of Norwegian-sourced ice-rafting events onto the Vøring plateau, some of which correlated with Heinrich events, and some did not. **Andrews** favoured an internal glaciological mechanism for generation of the ice-rafting events and **Boulton** recapitulated evidence that internal oscillations can arise readily from ice sheet models. In discussing model results on the Scandinavian ice sheet he emphasised the mismatch between accretion of the coldest, most isotopically light snow, and the subsequent maximum ice thickness. The implication is that it is only a catastrophic ice sheet retreat which will return the isotopically light ice to the oceans, but the lateral extent of the signal requires more consideration of oceanographic factors.

The CLIMAP reconstruction of 18 ka frozen seas from South Greenland to southern Ireland has been challenged in recent literature and by several speakers at the conference using evidence such as high foraminiferal diversity to indicate at least seasonally open water. A wealth of new data by **Spielhagen, Bauch, Weinelt, Stein, Sejrup, Hald & Dokken** and others within this zone indicate various spikes of ice-rafted debris influx and/or meltwater that, when synthesised, should give a much clearer picture of events in this crucial region. The timing of initial deglaciation was a point of particular interest and **Koç** reinforced conclusions of her recent *Geology* paper that although there was a rapid retreat of the Polar Front at 13.4 corrected (but not calibrated!) ^{14}C years, that the Nordic seas saw the initial warming, just as they currently are recording the insolation-forced cooling that will eventually take us into the next ice age.

Given the close attention that has been paid to the Younger Dryas event, and the rapidity of climate change, dating problems loom particularly large in the younger part of the record. A key approach is the correlation of dispersed volcanic ash which requires detailed documentation in the source area as described at the meeting by **Lacasse**, and recognition of unique events in both marine and terrestrial cores. For example the Vedde Ash (10.3 ka ^{14}C as dated on land) has been recognised in marine cores in new areas like the Hebridean shelf where work by **Kroon, Austin, Chapman** and **Peacock** showed that mollusc dates constrain the marine reservoir age effect to be 700 years compared with the standard 400 years assumed for the North Atlantic, whereas on the Scotian shelf **Stea *et al.*** found it was zero. In an engagingly robust presentation, **Heier-Nielsen** demonstrated data from areas of high sedimentation rates in the Skagerrak that showed that benthic foraminifera of pristine appearance may nevertheless be reworked and therefore give misleading ages. Another strong contribution from **Wohlfarth** firstly emphasised the quality of

the Swedish varve chronology and its relationship to ^{14}C dates and secondly showed how this seemed to be incompatible with the intercalibration of ^{14}C and U-Th dates and with dates from ice core layer counts. The Younger Dryas would have ended at 11 ka not 11.6 ka as ice core data suggest. Also, in the interval of 12.5-13 varve ka at the end of the varve chronology, the ^{14}C dates are changing very rapidly, and hence moving towards equality with the varve years. In discussion it was pointed out that there was a gap in U-Th-dated corals at this time, so that the ^{14}C effect might have been reversed further back in time, but **Hajdas'** Swiss lake data appear to reinforce **Wohlfarth's** conclusion by carrying the chronology a little further back (although fixed at the young end by dendrochronology rather than directly to modern events).

The Younger Dryas event is marked, at least in part, as Heinrich layer H-0 in the Labrador Sea but **Duplessy**, in deriving both summer temperatures and salinities from assemblages and $\partial^{18}O$ values of planktonic foraminifera, was able to show that there was no sign of surface lowered salinities from meltwater plumes within the Younger Dryas event, although we do not know if this applies at the time of its inception. **Hald & Dokken** and **Koç** emphasised that the Younger Dryas event was barely recognisable in the far north, and **Boulton** showed that it would scarcely feature during the rapid retreat of the SE side of the Scandinavian ice sheet on a deformable bed, yet it is manifest in Denmark and southern Sweden by visually spectacular changes in lake sediments described by **Bjork *et al.***. They clearly showed the presence of the precursor Amphi-Atlantic oscillation and the simultaneous response in terms of lake productivity over a 400km traverse. At the termination (9900 ^{14}C years, just after the end of the ^{14}C plateau), ostracod $\partial^{18}O$ values indicates an "immediate" 6-8°C temperature rise.

Another ostracodal highlight was the demonstration by **Cronin** that in the marine realm ostracod Mg content could provide a valuable new temperature indicator. Although suffering the detached euphoria of the jet-lagged, he gave a careful evaluation of the potential problems of the method, particularly in estimating temperatures below 4°C. Nevertheless, Pliocene variations in cold-water ostracod composition at 41 ka intervals give cause for optimism.

In summary of the lecture and poster programme, it was strong on all sorts of new data and evidence of timings, but the implications for Atlantic circulation patterns were not discussed in any detail and far more new problems were raised than old ones solved. But how much better it is for the modellers to be constrained by more and better data such as we saw presented.

Ian Fairchild
University of Birmingham

SUBGLACIAL PROCESSES WORKGROUP
FIELD WORKSHOP, LLEYN PENINSULA
10th-12th March 1995

The Lleyn Peninsula provided a spectacular setting for the third Subglacial Processes Workgroup, which is attracting an evergrowing body of scientists. The workgroup of fifty-two promoted a friendly, lively and stimulating atmosphere in which primarily subglacial, but also proglacial, lacustrine, debris-flows, alluvial fans, deltas and scree deposits were discussed, with sections at Porth Neigwl, Dinas Dinlle and Aberdaron generating a good deal of interest as well as debate.

On Saturday morning the convoy of vehicles manoevered itself out of Aberdaron and headed east towards Rhiw, which provided a good viewpoint of the drift-filled embayment behind the section of Porth Neigwl, our first destination. The masses gathered in the sunshine at the eastern end of the Porth Neigwl (Hell's Mouth) section, represented by debris-flow and alluvial fan deposits. **Danny McCarroll** (Swansea) believes that the remaining parts of the section (1.8km) represents a complex record of changing sedimentary environments and evidence of glaciation from both the Irish Sea and Welsh ice. A seismic survey carried out by **Pete Brabham** (Cardiff) suggests that the thick drift we were about to inspect extended 30 to 40m below datum. Following the section further west, a thinning and fining sequence from diamicts through to lacustrine laminated silts and sands thought to represent the melting and retreat of the Welsh ice is observed. About quarter of the way along the section, some frenzied digging revealed a wedge of diamict resting at a steep angle over a unit of sands. **Danny McCarroll** suggests that this represents a wedge of the lower diamict (Irish Sea Till), which has been thrust up and over the sands of the IWS (a sequence of sands resulting from local ponding on the surface of stagnant Irish Sea Ice) and marks the limit of advance of the Welsh ice. It was widely agreed that this diamict had been thrust from east to west, up and over the sands forming an impressive shear zone. The rest of the section is dominated by a ridge of clay-rich matrix-supported calcareous diamict ('Irish Sea Till'). No major disagreements as yet.

A fodder stop was taken at the Sun Inn, Llanengan where we all devoured a bowl of cawl, after which we headed for Dinas Dinlle, an impressive section on the north coast of the Lleyn. **Jane Hart** (Southampton) put forward a drumlin theory of formation for this section, whereby folding and thrusting occurred in a subglacial deforming layer, producing an anticlinal core of fluvial sands and gravels overlain by thrust sheets of diamict, gravels and sands. Jane went onto

point out this section, together with the other drumlins in the area, could delimit the margins of the Irish Sea and Welsh ice. **Graham Williams** (Keele) at this point produced an impressive seismic profile running parallel with the section, which showed a remarkably accurate continuation of the fault planes identified by Jane. **Graham Williams** and **Danny McCarroll** suggested that this section represented push moraines. It was agreed that some kind of compressional force had occurred in a northeast to southwest direction. There was a noticeable lack of any vocal support for the glacimarine theory at this and other sections.

On the return journey we stopped at Rhyd-y-clafdy which provided a good viewpoint for a series of terraces, which reach heights of 86m. **Danny McCarroll** disputed the theory of formation put forward by Eyles and McCabe who argue that these terraces represent Gilbert-type deltas, arguing instead that they had been formed by ponding, together with uncoupling and retreat of the Welsh ice. However, the lack of exposures in these terraces and related sedimentary evidence meant that the rest of the group could readily dispute this, vocal contributions being led by **Willy Warren** (Irish Geological Survey), **Jim Rose** (Royal Holloway) and **George Dardis** (Anglia). Two local ponies showed a good deal of interest in Danny's musings and showed their appreciation by salivating over both his and Roger Dackombe's heads, much to the amusement of the rest of the group. The general consensus of opinion was that a JCB was required to solve this one.

The evening was spent eating a wonderful buffet and discussing the merits of both the excellent poster displays and the beer.

Sunday morning kicked off with a lively dispute of the Aberdaron section. This section is dominated by two deformed diamicts, with extensive sand and gravel beds in the upper diamict. **Jane Hart** suggested that the section represented subglacial deformed diamicts, with gravel pods and competent gravels and included a buried drumlin. **Danny McCarroll** argued that this section represents meltout tills passing up into proglacial outwash gravels and debris-flows. Some questioned the interpretation of meltout tills in terms of scale, since it was known that the section extended for a further 30m below datum.

The final location was the picturesque Porth Ysgo which was bathed in glorious sunshine. The group made their way down to the beach to view a section of pre-Late Devensian scree deposits, protected from glacial erosion because of their position in the lee of a fossil cliff. Moving along the coast to the east at Porth Alwm is an intriguing facies which contains boulders up to 5m. The provenance of these boulders is the lower ultrabasic (picrite) part of the layered intrusion

of Mynydd Penarfynydd to the east and northeast. Various interpretations of this facies were put forward including debris-flows and glacial, but a firm conclusion was not reached. This led onto a philosophical discussion of interpretations and hypothesis testing. **Danny McCarroll** received an enthusiastic round of applause for organising what turned out to be both an excellent and thought provoking weekend. With enthusiasms running high, **Jane Hart** announced that the next meeting was to be held at Cromer in October 1995. The group headed back for the minibuses, scrambling over the picrite boulders that littered the beach and inspecting the axles, pulley frame, adits and shafts of a disused manganese mine.

Lots of hand shaking, goodbye's and "I'll see you at the next meeting," filled the air in Aberdaron before everybody reluctantly departed, a sure sign that an enjoyable weekend was had by all.

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REVIEWS

PLEISTOCENE ENVIRONMENTS IN THE BRITISH ISLES

By R.L. Jones and D.H. Keen
Chapman & Hall, London
ISBN 0-412-44190-X 1993. 346pp. Soft-cover £24.99

Interest in the Quaternary deposits of the British Isles has mushroomed in the last twenty years or so and it was only a matter of time before someone attempted a synthesis. This book "aimed at undergraduates taking options in Pleistocene studies, and postgraduate and more experienced scientists" has been written to meet this obvious need. In this review the emphasis is focused on the environmental changes that have affected the British Isles (taken to include Ireland, Isle of Man, Channel Islands and the offshore continental shelf), rather than on providing details of the many methods and techniques that have been used to elucidate them. Chapter 1 ("Background"), however, does consider the types of evidence available and provides brief outlines of the principal techniques. The main body of the book reviews the succession in stratigraphical sequence beginning with Chapter 2 ("Prelude to the Pleistocene") and ending with Chapter 10 ("The Flandrian Temperate Stage"). A two page Epilogue (Chapter 11) follows and the book concludes with an extensive 56 page list of references and an index.

The character of each stage is outlined and lists of important fossils (vertebrates, molluscs, plants and microfossils) given. It is unfortunate that Chapter 3 ("The Lower Pleistocene before the Pre-Pastonian") was written before the publication of the results of an Anglo-Dutch working group that proposed new correlations across the North Sea Basin (*Quaternary Science Reviews* 10, 23-52). The Antian and Bramertonian Stages are now regarded as probably identical whereas the Pastonian Stage has been correlated with the Late Tiglian (TC 5) and included in the Lower Pleistocene, together with part of the Beestonian. The Ludhamian is probably Early Tiglian and the Pre-Ludhamian may equate with part of the Praetiglian Stage.

For the Middle and Upper Pleistocene, critical sites are discussed on a regional basis. An important message of the book is the belief that additional stages have occurred that have hitherto been unrecognised in the terrestrial record in Britain. Particular attention is focused on "Post-Hoxnian and pre-Ipswichian events" (Chapter 7) and the re-evaluation of some sites formerly included in the Last (Ipswichian) Interglacial. The case for an additional temperate stage, believed to equate with stage 7 of the marine oxygen isotope record, is reviewed. Distinct faunal differences are apparent between sites that are

indistinguishable on the basis of pollen stratigraphy. Independent support for the belief that at least two interglacial stages have been confused is provided by amino acid data, although these are also sometimes anomalous.

The format of the book, with each stage discussed in sequence and by region, would seem logical, but I must confess to being somewhat disappointed with the rather mechanical way that this information has been assembled. In places it appears as if the data from each site have simply been taken from a stack of file cards. This impression is strengthened when one finds the same taxon listed under different names from different sites within the same paragraph! For example on page 91, the cockle is listed correctly as *"Cerastoderma"* from a number of Hoxnian sites but by its old name *"Cardium"* later in the same paragraph. Similarly, on p.236 no attempt has been made to standardise nomenclature and the dog-whelk is listed variously as *"Purpurea"* and *"Nucella lapillus"* and there are several other such examples. I noticed other inconsistencies. For example, I could not understand why on Fig. 6.1 a possible Hoxnian coastline is shown joining Slindon (= Boxgrove) and Bembridge when these sites had already been discussed in Chapter 4 ("The Cromer Forest-bed Formation and associated deposits").

Leaving aside these inconsistencies, I was frustrated by the general lack of any critical reappraisal of the evidence from many sites (Chapter 7 excluded). The discussion on the age of the Hoxnian (pp. 96-7) exemplifies the problem, for it merely consists of a catalogue of age estimates ranging from 25,000-21,000 yr BP to 428,000-352,000 yr BP without any assessment of the quality or reliability of each. Elsewhere I also felt that there was often too much trivial, non-essential information included. The non-palaeontological reader will find it difficult to distinguish the really important fossil records from the incidental occurrences.

Despite these reservations the book is extremely useful and provides a convenient way in to the British Quaternary literature. The extensive reference list alone is quite indispensable! The book will be especially valuable to regular QRA punters and is, in effect, a "QRA Guide to the British Isles"! It has been published at a reasonably sensible price and I have no hesitation about recommending it to all such people. Indeed, I assume that most will already have a copy. For the reasons given above, I am less certain whether I can give such an endorsement to the intended undergraduate readership. They, I suspect, will find it difficult to use and rather turgid to read. This is a great pity, for with a little bit more care and imagination this could have been an excellent book.

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GLACIAL ENVIRONMENTS

By M. J. Hambrey
University College Press, London
ISBN 1-85728-004-01994. 304pp. Paperback £14.95

Considering the number of earth scientists working on glacial sediments and environments, it may come as something of a surprise to find that the number of textbooks available for undergraduate courses is exceedingly limited at the present time. Apart from the classic text by Sugden and John (1976) which was written some twenty years ago, more recent excellent textbooks such as Drewry (1986) are sadly out of print. This is something of a problem when running an undergraduate course in glacial geomorphology and it was therefore with some relief that this latest book by Hambrey looked as if it was just the thing to fill this niche on the bookshelves, particularly since it is extremely well priced for the student market.

The book is divided into eight chapters following a traditional format - glacier dynamics, glacier erosion then on to glacial deposition. It is the last of these to which the bulk of the book is focussed although the balance with respect to sedimentary processes is predominantly towards the marine environment; for example the chapter on terrestrial glacial deposition is 41 pages in length whereas the glaciomarine chapter is 83 pages which reflects the overall research of the author.

A positive aspect of this book is that it deals with the glacial record through geological time and does not restrict itself to late Cenozoic glacial activity. Examples are therefore drawn from many rock sequences of widely different ages. Many of these, however, are now explained within the glaciomarine sedimentary model (*cf* Eyles, 1993) and this is clearly reflected in the book. It is important to appreciate this point since it will influence undergraduates with respect to the interpretation of glacial sediment sequences, particularly since glaciotectonic deformation is not dealt with in the same detail. Since it has yet to be decided whether the glaciomarine school has won the argument regarding the interpretation of the glacial record, it is perhaps best in an introductory textbook to try and present the evidence without bias.

The overall layout of the book is clear and well presented with good line diagrams and many half tone illustrations. Unfortunately there are a number of typing errors in the captions, for example the geological timescale in the frontispiece. Bearing in mind that this book is the first introduction of an undergraduate to the subject matter it is unfortunate that there are notable exceptions to the clarity of the diagrams, such as Figure 4.7b which is not explained as a photomicrograph, Fig. 5.7 which needed an arrow to direct the

reader to the feature under discussion and Fig. 6.7 where you need to hunt for the parallel roads if you are unfamiliar with them. The diagram with the greatest mistakes is Fig. 2.3 - no prizes for spotting them!

The discussion in Chapter 1.2 on the basic terminology is no help to undergraduates just beginning to read the literature. A general textbook on glacial sediments must explain the terminology, such as the difference between till and diamict and all the other subtle variations with clarity. This is, of course, particularly true when having to debate a glaciomarine and glacial deformation origin. Strangely, there was no real discussion on stratified diamict.

In a number of chapters, the overall structure does not help the presentation of material. Because each chapter is divided into sections and then further subsections, topics are dealt with in one paragraph, often at a very general level or are covered in a number of different chapters. For example, the discussion on fabric was very difficult to follow with the topic being introduced in Chapters 1.4.3, 4.4.3, and 8.4.4 particularly since the section 4.4.3 actually discusses the diagram included in the first chapter and 8.4.4 discusses terrestrial fabrics in a chapter on glaciomarine environments. Other examples of this could be cited - for example, the rather general description and discussion of glaciofluvial processes and landforms and the repetition of material between the three chapters which describe glacio-aqueous sedimentation in a general sense.

I was generally disappointed with *Glacial Environments* which on first impressions seemed to be just what was needed for a course book. It has a number of flaws in terms of design which has not allowed the scientific information to be presented or explained in the best way for undergraduates. Furthermore it is strangely unbalanced in terms of cover and depth of explanation. So the field is still open to see who can produce a glacial geology textbook of high scientific quality at a price the students can afford - a challenge for the Cutting Edge Club!

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PALAEOCLIMATES AND THEIR MODELLING WITH SPECIAL REFERENCE TO THE MESOZOIC ERA

Edited by J.R.L. Allen, B.J. Hoskins, B.W. Selwood, R.A. Spicer and P.J. Valdes
The Royal Society, Chapman and Hall, London
ISBN 0-412-56330-4 1994. 140pp. £35.

There is no doubt that many important advances in understanding earth system processes have resulted from the collaboration of Quaternary geologists and climate modellers. Data-model comparisons have made it imperative that we seek more quantitative palaeoclimate estimates from a wider range of geologic variables. Many of us have become more aware of the complexities of climatic change - long-term changes in seasonality, for example. The models have also made it necessary to collate a variety of palaeoclimatic data at continental scales, a process that has encouraged a wider, more interdisciplinary view of our subject, and spawned a number of international collaborative projects.

This volume, with its striking red and blue cover depicting a map of model-simulated Cretaceous surface temperatures against a background of fossil wood, is evidence that pre-Quaternary geologists are equally active, despite the formidable difficulties of modelling a world so fundamentally different from that of the present. The book is a collection of sixteen papers delivered at a Royal Society Discussion Meeting, and also published in *Philosophical Transactions*, 1992. It includes papers by several Quaternary scientists; perhaps surprisingly, a general overview of the achievements of work involving Quaternary palaeoclimate models, comparing Quaternary and pre-Quaternary approaches, is lacking.

Shackleton's opening paper is a short but masterly review of current understanding of responses to orbital forcing and of the possible causes of climatic trends over six million years. Given that we cannot model the interacting components of the global climate system for the recent past, Shackleton warns against imagining that model output actually describes the climate system of the distant past. The value of models is that they stimulate investigators to collect new geologic data. Huntley provides a useful review of the application of climate response surfaces for quantitative palaeoclimate reconstruction from fossil plant remains, with a wider discussion of the assumptions underlying this and related approaches. The most fundamental of these, that taxa have not evolved since the time under consideration and that

they have not altered their climatic tolerances, does not of course apply to pre-Quaternary time, but a broader approach involving plant functional types may permit at least identification of the range of past climates. Allen reviews a variety of geologic indicators for the strength and direction of past winds, most of which are from arid climates. His work on mid-Holocene tree remains in the Severn estuary is one of the few examples of palaeowind inferred from humid environments; the results form an integrated record of storms associated with the westerly zonal circulation.

Berger and co-workers describe a number of experimental simulations of global ice volume for the last two glacial cycles, using a statistical-dynamical model that is computationally less demanding then the more familiar GCMs. The results highlight the importance of atmospheric CO_2, and of feedbacks involving water vapour and surface albedo, in driving the climate system. Mitchell reviews the results of a variety of GCM simulations for the mid-Holocene and the last glacial maximum, as well as model experiments into the possible causes of ice sheet initiation. He concludes by summarizing the weaknesses of current models, which may be remedied after a systematic comparison of models, as in the current Palaeoclimate Modelling Intercomparison Project.

Does work involving palaeoclimate models for pre-Quaternary time periods have any lessons for Quaternary scientists? Not many that I could detect, but a more astute or experienced reviewer could no doubt find some. One is that a good deal can be achieved without recourse to species-level taxonomic precision, as is already evident from the success of biome models using plant functional types. I found it interesting that modellers have not yet completed experiments to assess the sensitivity of Cretaceous climate to orbital forcing, focussing instead on the relative influence of continental geography and CO_2 on Cretaceous warmth.

Overall, this collection of papers is probably of less value to workers in the Quaternary than the Mesozoic, but it is a thought provoking compilation nevertheless.

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BRITISH GEOLOGICAL SURVEY OFFSHORE QUATERNARY MAPS

Holmes, R., Jeffrey, D.H., Ruckley, N.A. and Wingfield, R.T.R. 1993
Quaternary Geology around the United Kingdom (North Sheet), 1:1,000,000. (Edinburgh: British Geological Survey.)
ISBN 075102 flat, ISBN 07518 29110 folded
and
Holmes, R., Jeffrey, D.H., Ruckley, N.A. and Wingfield, R.T.R. 1994
Quaternary Geology around the United Kingdom (South Sheet), 1:1,000,000.
(Edinburgh: British Geological Survey.)
ISBN 07518 29192 flat, ISBN 07518 29137 folded
£30.00 pair

These recently published maps represent an important synthesis of data collected by the British Geological Survey (BGS) over an interval of more than two decades (1967-1990) as part of a programme to map the geology of the United Kingdom's continental shelves.

The maps themselves, published to a very high standard by the BGS, are the latest of three double sheet maps at the 1:1,000,000 scale. The other maps in this series include the Sea Bed Sediments around the United Kingdom and the Geology of the United Kingdom, Ireland and the adjacent continental shelf. Related publications with descriptions of the Quaternary geology are included in the BGS series of UK offshore regional reports and the BGS Quaternary series of 1:250,000 scale maps.

Perhaps the greatest achievement of any mapping project at this scale is the synthesis of such a vast amount of data. When considering the wealth of information presented it should be noted that the geological data sources employed in compiling these maps have included: The Institute of Oceanographic Sciences; The Geological Survey of Ireland; Department of Geology, University College London; School of Environmental Sciences, University of East Anglia; School of Ocean Sciences, University College North Wales; School of Biological Sciences, University College Swansea; Institute of Earth Studies, University of Wales, Aberystwyth; Rijks Geologische Dienst (Geological Survey of the Netherlands); Institutt for Kontinentalsokkelundersøkelser (Continental Shelf Institute, Norway). Additional information on seabed topography was compiled from BGS surveys and from surveys by the Hydrographic Office, Ministry of Defence.

The explanation of colours and symbols are well set out and clear on both sheets, although the subdivision into lithological units is rather limited and could have been expanded. An attempt has been made to place the mapped BGS formations and sequences into a framework of Quaternary chronology, but this has clearly resulted in oversimplification (see discussion below). The line of section figures (eight cross-sections north sheet, nine cross-sections south sheet) are generally well located and are provided with some useful pre-Quaternary stratigraphic determinations. One of the most valuable features of the map must certainly be the inclusion of Quaternary isopachytes. Both sheets have smaller scale summary maps included and these provide useful overviews at the 1:6,000,000 scale. The north sheet features a summary of the depth to base Quaternary below mean sea level and a summary of the evidence for shelf glaciation. The south sheet features a seabed topography map and a summary of shallow gas on the shelf and in the Norwegian Trench.

Probably the greatest headache facing the authors of this map was how to relate the mapped BGS formations and sequences to the established Quaternary time scale. The reader should remember that the original 1:250,000 Quaternary sheets were produced by a large number of individuals working within BGS and elsewhere over a period spanning more than twenty years, often relying on data coverage and data quality of differing standards. The large scale sub-sea mapping of complex Quaternary units is itself not an easy task, but assigning ages becomes highly problematic, particularly when the borehole coverage for the area as a whole is limited. The authors have attempted to combine the available information and many of the mapped units will, in reality, overlap considerably and differ in actual age. Faced with what must have been a plethora of often contradictory evidence, even from adjacent 1:250,000 sheets, the authors are to be congratulated for what is undoubtedly a valuable synthesis of the Quaternary geology around the shelf seas of the United Kingdom.

A number of interesting features are illustrated, many of which will no doubt encourage debate for many years to come. The 1:6,000,000 summary map of shelf glaciation, for example, illustrates our generally very poor understanding of ice limits around the British Isles even during the Late Weichselian. In fact, glacial ice limits are difficult to define and the maps instead show evidence for "outer preserved limit of ice-proximal diamictons" and "outer preserved limits of closed valleys". For example, these problems are well illustrated from southwest Britain, where the preserved limits of closed valleys assigned to the Weichselian and Elsterian are largely coincident, while those assigned to the Saalian are less extensive. However, the outer preserved limits of Weichselian ice-proximal diamictons extend much further to the southwest, although they

may only represent a relatively brief period of ice sheet advance, not necessarily related to the climatic glacial maximum (see discussion in Scourse *et al.*, 1990). The limits of land ice sheets have also been included and are based on data from Bowen *et al.*, (1986); the relationship between the marine and terrestrial records provides much food for thought.

The maps provide a wealth of additional features and there is bound to be something of interest for anyone who has an interest in the Quaternary or the shelf seas in general. But more than this, these maps will inspire further research. The shelf seas offer very many possibilities for future research into the Quaternary history of the United Kingdom and beyond, providing a vital link between the terrestrial and open ocean North Atlantic climate records. I would therefore recommend these sheets to anyone with the scientific inclination to gaze out to sea!

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ABSTRACTS

THE LAND-USE HISTORY OF THE SOUTHERN ENGLISH CHALKLANDS WITH AN EVALUATION OF THE BEAKER PERIOD USING ENVIRONMENTAL DATA: COLLUVIAL DEPOSITS AS ENVIRONMENTAL AND CULTURAL INDICATORS

Michael John Allen (Doctor of Philosophy)
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ABSTRACT

Recent studies have demonstrated that colluvium is present on the chalklands of southern Britain and have indicated its anthropogenic causal relationship. However, although the extent of hillwash has, to some degree, been identified, its occurrence as significant blankets covering archaeological sites and its potential to aid with the interpretation of land-use in the past was unclear. The opportunity was therefore taken to use these deposits in conjunction with detailed land snail analysis from both colluvium and traditional archaeological contexts to interpret land-use in the past.

The Beaker period, which contains a series of distinctive artifact types, was specifically examined. This allowed an examination of land-use in an attempt to identify any specific changes which could be seen to accompany this new material culture. The value of using the Beaker period is that it has a short duration (2300-1800 BC), is distinctive and is seen as a marker horizon of human change..

An interpretation of land-use and soil change was largely made by the study of colluvium and by extensive land snail analysis. Observations of modern erosion events allowed the recognition of the precise mode of deposition of ancient colluvium. This also allowed detailed interpretation of past erosion events *per se* and the environmental conditions under which colluvium had accumulated. This research included a total of eight colluvial investigations (three of which involved detailed hand excavation) and land snail analysis from a further twelve sites.

Four study areas were examined: Lewes Downland, Isle of Wight, Salisbury Plain and Dorchester environs. In each area (except Dorchester) smaller areas were examined in more detail. The Dorchester area as a whole was small enough to allow detailed coverage. At least one major colluvial sequence was excavated in each area, using established methods, and complemented by land snail analysis from adjacent sites of the same or similar periods.

In many locations archaeological sites and artifact scatters were buried by up to 3m of hillwash. Even buried Beaker land surfaces with cultivation marks were excavated under hillwash.

Despite the major changes in the culture assemblages associated with Beaker communities, no comparable change in land-use or expansion of farming could be detected. The thesis concludes that Holocene colluvium can be assigned to an anthropogenic, rather than climatic, origin.

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THE CHRONOLOGY OF COVERSAND DEPOSITION IN BRITAIN

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ABSTRACT

This thesis presents the results of a study of the distribution, stratigraphy, age, and sedimentology of the major aeolian coversand deposits in South-West Lancashire, North Lincolnshire and East Anglia.

In particular, the thesis reports the first systematic application of luminescence dating to coversands in this country. A large number of absolute age determinations have been produced using both luminescence and radiocarbon techniques. These dates provide good age control for coversand deposition. Luminescence dates were obtained, from both the feldspar and quartz grains within the sands, using thermoluminescence (TL), infra-red stimulated (IRSL) and green light stimulated (OSL) luminescence techniques. Both accelerator mass spectrometry (AMS) and conventional radiocarbon dates were obtained from organic deposits intercalated with the sand, and these age determinations were in good agreement with the luminescence dates.

The absolute ages are supported by relative ages obtained from stratigraphical, palynological, coleopteran and molluscan evidence. Two periods of sand deposition have been dated in Lincolnshire, the main one during the Loch Lomond Stadial, terminating with the start of the Flandrian and an earlier, short-lived phase, at c. 15,000 years ago. Coversand deposition in Lancashire was also during the Loch Lomond Stadial although reworking of the sands since deposition makes the application of luminescence dating difficult. The East Anglian coversand was deposited around 14,500 years ago and, so, is not contemporary with other British coversand sheets. British coversand deposition, therefore, coincided with the Younger Coversand I and Younger Coversand II phases in the European coversand chronology.

Palaeo-environmental data, mostly from pollen, has been used to reconstruct an open arctic tundra environment, dominated by grasses and sedges, prior to and during sand deposition in Lancashire and Lincolnshire.

Surface texture analysis of quartz grains shows a dominance of aeolian features with some samples also showing degraded fluvio-glacial characteristics. This

confirms the dominance of aeolian sand transportation and a local fluvio-glacial source for the Lincolnshire and Lancashire sand. In Lincolnshire, particle size analysis shows no spatial grain size trends within sand deposits of similar age although differences within the Trent and Ancholme river valleys suggest that sand transportation was mostly confined to within the separate river valleys. The increased thickness of sand banked up against the westernmost cuesta scarp slopes suggests westerly transportation of the sand.

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FUNGAL SPORES AS PALAEOENVIRONMENTAL INDICATORS OF ANTHROPOGENIC ACTIVITY

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ABSTRACT

Fungal spores often occur in palynological preparations and have been successfully incorporated in both biostratigraphic and palaeoenvironmental investigations. However, the majority of palynologists choose to ignore such microfossils, primarily because of the difficulties relating to their identification. Where they have been used conventional palynological extraction procedures have been implemented in the preparation of samples. The suitability of such techniques for the recovery of fungal palynomorphs has been assumed in many cases.

The objectives of this thesis were to study the effect of different processing techniques on the recovery of fungal palynomorphs, to propose a suitable morphological recording system and to investigate the potential of using fungal palynomorphs as palaeoenvironmental indicators of anthropogenic activity.

Following the specification of a suitable extraction procedure for fungal palynomorphs and an appropriate morphological recording system 215 types were described. These types were encountered in samples from modern and archaeological situations and across a variety of different environments. The types fall into 19 morphological categories as defined in the recording system. Many of the types are restricted to either modern or archaeological sample sets although some are common to both. 96 types are comparable to known fungal taxa, eight are considered algal in origin, four are parasite eggs and one has been identified as a rhizopod species. The remaining 106 can only be classified morphologically until they can be related to known taxa.

Although an objective was to employ the Comparative Approach and use the palynomorph assemblages from known modern environments in the palaeoenvironmental interpretation of the archaeological material, it was not feasible. This is principally because of the limited overlap of taxa between modern and archaeological samples and is most likely a reflection of the restricted range of material considered. However, this approach demonstrates a promising future, subject to more extensive sampling regimes.

Palaeoenvironmental interpretation of the archaeological samples was possible using the Indicator Species Approach. The results support and often enhance other forms of palaeoenvironmental analysis and in no instance were contra-indications encountered.

This success testifies to the importance of fungal palynology and the need for continuing research in this area.

PREHISTORIC FIELD SYSTEMS AND THE VEGETATION DEVELOPMENT OF THE GRITSTONE UPLANDS OF THE PEAK DISTRICT

Deborah J. Long (Doctor of Philosophy)
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ABSTRACT

Small valley mires situated adjacent to prehistoric field systems on the East Moors of the Peak District have been dated typologically and by radiocarbon dating to the second millennium BC. These have been used as sources of evidence for environmental change, brought about primarily by prehistoric human activity. The mires have been examined using pollen, spore, charcoal and stratigraphic analyses. Regional vegetation change from the third millennium BC is illustrated in a core from a raised mire site, central to the study area.

Of the small valley mire sites studied, two display similar stratigraphic sequences where clay, containing pollen types indicative of agricultural activity, is overlain by peat. Palynological evidence from the valley mire sites indicates that woodland clearance with arable activity was occurring in localised areas across the East Moors from the second millennium and through the first millennium BC.

Evidence from a core taken through one of the stone boundaries in a cairnfield complex above the valley mire site at Stoke Flat suggests that the fields and boundaries were associated with this agricultural activity.

Radiocarbon dating has indicated that at the valley mire sites, peat accumulation started with the decline of evidence of agricultural activity at the end of the first millennium BC. Although local conditions vary at each site, there is evidence that agricultural activity in the vicinity of the field systems occurred through the first millennium BC, towards the end of which evidence of agricultural activity declines and moorland species became established. Following widescale woodland decline at the end of the first millennium BC, evidence suggests that regeneration was prevented by increased grazing pressures, climatic change, increased rates of soil deterioration and the possible abandonment of former woodland management practices.

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NOTICES

1. WORKSHOP ON GLACIATION AND HYDROGEOLOGY

Workshop on the Impact of Glaciations on Rock Stresses, Groundwater Flow and Hydrochemistry - Past, Present and Future

Funding Organisations: The Swedish Nuclear Power Inspectorate (SKI) and the Swedish Nuclear Fuel and Waste Management Co (SKB)

Venue: Stockholm, Sweden
Date: 17-19 April 1996

Assessment of the long-term safety of radioactive waste disposal requires assimilation of evidence for the impact of glaciation on the geosphere, particularly in terms of its implications for the distribution and stability of stress regimes, groundwater flux and flow patterns and groundwater chemistry.

This workshop is intended to promote scientific discussion and the exchange of information and ideas between a wide range of disciplines such as glaciology, hydrology, hydrogeology, geochemistry and structural geology. Participants from outside the radioactive waste community will be particularly welcome, although workshop numbers will be limited.

Of particular need are palaeosignatures, direct observational information and models of the impact of continental ice sheets and periglacial conditions on stresses, groundwater flow and groundwater chemistry of crystalline bedrock.

An additional, optional one-day field excursion may also be organised to a local area of glaciological interest, dependent upon the degree of interest.

For further information, to suggest discussion areas and to register interest please contact:

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2. JGS WELCOMES QUATERNARY MANUSCRIPTS

On taking over as chief editor of the Journal of the Geological Society, I would like to encourage members of the QRA to consider publication of appropriate manuscripts with us. As one of the subject editors since 1989 I have dealt with a steady trickle of good Quaternary papers and I am pleased to be able to write this note a few days after publication of our May issue which includes an important paper by Kurt Lambeck on Late Devensian and Holocene shorelines, and an informative exchange of views between Gibbard and West and Ashton, Bowen and Lewis on the use of amino acid ratios and the correlation of terrestrial sites. Recently Graham Shimmield has joined the editorial Board as subject editor and Jim Rose as advisory editor, demonstrating our future commitment to Quaternary studies on land and under the sea!

Like other scientific societies, The Geological Society is committed to wide dissemination of scientific results. Several thousand individuals and nearly 700 libraries receive copies, which makes it one of the most widely available journals in the earth sciences. We are also well set up to minimise the time involved in the handling of papers; particularly rapid publication is given for "Specials" which are timely and important contributions up to 4 printed pages.

As a general international journal we have an emphasis on papers which will interest people outside one particular discipline. Indeed, a common reason for manuscripts to be rejected is that they appear to be written for a specialist journal. This means that we welcome authors who realise the varied interests of their potential readers and who make efforts to place their results within a broader context. So, if your latest results had your coffee room colleague hooked, send them along!

Ian Fairchild
i.j.fairchild@bham.ac.uk

3. PEOPLE AS AN AGENT OF ENVIRONMENTAL CHANGE

Annual Symposium of the Association for Environmental Archaeology, University of Bradford, 7th-10th September 1995.

Cost: £15 Registration Fee (except Speakers), daily full board £33.50

Further details of this meeting may be obtained from the organiser, **Dr Terry O'Connor, Department of Archaeological Sciences, University of Bradford, Bradford BD7 1DP, U.K. (tel. 01274 383541/fax 385190/e-mail TPOConnor@Bradford.ac.uk).**

4. POSTGRADUATE SHORT COURSES IN QUATERNARY SCIENCE

Centre for Quaternary Research (CQR)
Royal Holloway, University of London (RHUL)
and
Environmental Change Research Centre (ECRC)
University College London, University of London (UCL)

The University of London MSc in *Quaternary Science* course, formerly taught by the CQR, RHUL, has been expanded and is now taught jointly with the ECRC, UCL, in consortium with staff from the Universities of Kingston, Oxford and Reading, and the Natural History Museum (London). This course is recognised by the N.E.R.C., and was this year awarded a N.E.R.C. studentship.

Individual Option Course Units are also being offered to students from other institutions for training purposes. Each course unit comprises one week (Mon.-Fri.) instruction, with the exception of Diatoms, which is a two-week course. Students successfully completing each course unit are awarded a Certificate of Completion. The fee for each course unit ranges between £200 and £300. The following units will be offered in the 1995-96 academic session, scheduled between Dec. 95 and April 96:-

- *Glacial Sedimentology* (L.A. Owen, RHUL)
- *Periglacial Geomorphology, Soils and Sedimentology* (P. Worsley, PRIS, Reading)
- *Palynology* (H.J.B. Birks and S. Peglar, UCL/Bergen)
- *Diatom Analysis* (R.W. Battarbee, T. Allot and V. Jones, UCL)
- *Quaternary Soils* (R.A. Kemp,RHUL)
- *Ostracod Analysis* (J. Holmes, Kingston)
- *Insects in Quaternary deposits* (G.R. Coope, RHUL)
- *Chironomid Analysis* (S. Brooks,Nat. Hist. Mus.)
- *Plant Macrofossil Analysis* (H.H. Birks, UCL/Bergen)

- *Quaternary Fluvial Systems* (C.P. Green, RHUL)
- *Palaeoenvironmental Reconstruction in Low Latitudes* (A.S. Goudie, Oxford)
- *Theory and Applications of Luminescence Dating* (E.J. Rhodes, RHUL)
- *British Quaternary Stratigraphy and Correlation* (J. Rose, RHUL)
- ° *Numerical Analysis of Quaternary Data* (H.J.B. Birks, UCL/Bergen)

For further details of course units marked •, and of the MSc course in general, write to **Prof. J.J. Lowe, Centre for Quaternary Research, Department of Geography, Royal Holloway, University of London, Egham, Surrey, TW20 0EX (Tel. 01784-443563; FAX: 01784-472836)**

For further details of course units marked °, write to **Prof. R.W. Battarbee, Environmental Change Research Centre, Department of Geography, University College London, Bedford Way, London WC1H 0AP (Tel. 0171-380-7575; FAX: 0171-380-7565)**

5. PAGES PROJECT STATUS AND WORK PLAN (1994-1998)

Past Global Changes (PAGES) is the IGBP Core Project charged with providing a quantitative understanding of the Earth's past environment and defining the envelope of natural environmental variability within which we can assess anthropogenic impact on the Earth's biosphere, geosphere and atmosphere. Through the organisation of coordinated national and international scientific efforts, PAGES seeks to obtain and interpret a variety of paleoclimatic records and to provide the data essential for the evaluation of prediction and encourages the creation of consistent analytical and data-base methodologies within paleosciences.

The PAGES Scientific Steering Committee has recently revised and produced the latest PAGES project status and Work Plan (1994-1998). This outlines the five foci into which the project is structured, namely: Global Paleoclimate and Environmental Variability, Paleoclimate and Environmental Variability in Polar Regions, Human Impacts on Past Environments, Climate Sensitivity and Modelling, Cross-project Analytical and Interpretive Activities by highlighting the current research activities under way, those recently completed and projects and workshops soon to be initiated.

More information and a copy of this report can be obtained from the **PAGES Core Project Office, Bärenplatz 2, CH-3011 Bern, SWITZERLAND.**

6. BERLIN INQUA CONGRESS 1995 (3-10 Aug. 1995)

The "Paleocarbon Symposium"

A special symposium of the 1995 Berlin INQUA Congress will be devoted to the theme of Carbon Cycle Changes during the Quaternary Glacial/Interglacial climatic transition.

How much carbon has to be sequestered in vegetation and soil to reconstruct the Holocene environment after the stress of the Last Glacial Maximum? How much carbon was released from the terrestrial realm between the last interglacial and the LGM when the glaciation was installed? What is the natural interaction between greenhouse gas, water cycle, vegetation and soil? These problems are important to solve because it may help to predict the future climate of our Planet. The very complex relationship between all parts of the Earth System is such that we have to rely on the recording of past changes that integrate the many positive and negative feedbacks.

Reconstructing the records of the past may help to validate present models still in their early stage. To predict the behaviour of the real Earth in the Future at the human species scale must remain one of the objectives of INQUA.

The Symposium follows on from the launching of the INQUA Paleocarbon project during the Beijing INQUA Congress in 1991.

At present 33 papers are to be presented in the "Carbon" Symposium. Various methods are to be proposed, based either on modelling and numerical simulation, or on mapping of past environments. The final programme of the session should include:

- Global changes in Carbon Cycle (10 papers)
- High latitude changes (6 papers)
- Middle and low latitude changes (12 papers)
- Carbon sequestration and release (oceanic and terrestrial) (5 papers)

The INQUA Carbon Symposium is intended to provide an open forum for launching a new international cooperative effort so as to understand and better quantify the amplitude of changes in the Carbon cycle. To this end a BUSINESS MEETING will also take place in Berlin as part of the INQUA programme. The

aims, objectives and structure of any future initiative will be discussed in an open forum session at the business meeting. Anyone interested in the Carbon cycle changes during Quaternary should contact the Organisers:

FAURE/VELICHKO/ADAMS at:
LGQ/CNRS/CEREGE - Europole de l'Arbois - B.P.80 - 13545 Aix-en-Provence, Cédex 04, France.

7. CALL FOR PAPERS: HYDROLOGY OF THE LAST MILLENNIUM

INQUA Berlin Symposium Aug. 5th 1995

This session is being organised by L. Starkel, K. Gregory, V. Annenkov and A. Brown on behalf of the Commission on Global Continental Palaeohydrology (GLOCOPH). The aim of the symposium is to foreground new and continuing research into the palaeohydrology of the last 1,000 years and its application to contemporary hydrology. It is increasingly being recognised that the instrumented period is not typical of the last millennium or the Holocene and that studies of natural variability and climate - hydrology coupling are potentially invaluable in scenario modelling of future climatic and hydrological change. The last 1000 years has also seen a dramatic increase in human impact on hydrological systems. Papers are welcomed from any field of palaeohydrology including; palaeofloods, palaeohydraulics, the recent alluvial record, historical hydrology, hydrological modelling and synoptic hydrology.

If you wish to give a paper please contact **Dr. A.G. Brown at: Department of Geography, University of Exeter, Amory Building, Rennes Drive, Exeter UK EX4 4RJ. Work: 01392 263331 / Mobile: 01278 856709 / Office: 01392 263341 / Switchboard: 01392 263263 / Fax: 01392 263342**

8. IGCP PROJECT 367: LATE QUATERNARY COASTAL RECORDS OF RAPID CHANGE

This new Project was adopted by the IGCP Board in January 1994 and the first International Meeting took place in Scotland, 13-20 September 1994. On my return from that meeting I received a letter informing me that the Royal Society's Earth Resources Committee had decided that it would be appropriate

for the UK to participate. I have accepted their invitation to become UK National Correspondent for Project 367 and organise a UK Working Group.

A description of the Project and the workplan outlined at the International Meeting is given below.

The first meeting of the UK Working Group was held in March at BGS, Keyworth, and attended by over 30 scientists. This group enclosed the 6 topics outlined below as providing the framework for the UK contribution.

If you wish to participate in this project please contact me at:
Ian Shennan, University of Durham, Department of Geography, Science Laboratories, South Road, Durham DH1 3LE. Telephone: (0191) 374 2484, (0191) 374 2466 (Secretary. Facsimile: (0191) 374 2456. Email: Ian.Shennan@Durham.ac.uk

The next meeting is a joint field excursion and business meeting, following the format of meetings of the UK Working Group for IGCP Projects 200 and 274, and will be at the University of Hull, 22-24 September 1995.

SUMMARY OF IGCP 367

Short title: Late Quaternary Coastal Records of Rapid Change

Full title: Late Quaternary Coastal Records of Rapid Change: application to present and future conditions.

Outline and main objectives:

1. To document and explain rapid changes (events that occur on the scale of seconds to 1000's of years) in the late Quaternary coastal zone. High resolution studies will be used to assess the impact of short term events on global and regional coastal change. These data will be used to suggest scenarios for future coastal changes and help in planning for possible coastline problems.

2. To provide, in final volumes and national reports, a set of reference material that documents regional and global short-term coastal events, and explains how these events relate to present and possible events in the near future.

3. To develop and prepare, through international meetings, newsletters, common data banks, etc., a common approach to these studies that allows comparison of data on a worldwide basis.

Project leader: David B. Scott, Centre for Marine Geology, Dalhousie University, Halifax, Nova Scotia B3H 3J5,Canada
Duration: five years, from 1994

First workplan to address some of the items in the proposal, developed at the meeting in Scotland:

1. Seismic events and tsunamis
2. Tidal amplitude changes
3. Storm surge history and change
4. Rapid sea-level change and response
5. Changes in sedimentation rate and response
6. New high resolution geochronological techniques

Ian Shennan, Department of Geography, University of Durham.

QUATERNARY RESEARCH ASSOCIATION

The Quaternary Research Association is an organisation comprising archaeologists, botanists, civil engineers, geographers, geologists, soil scientists, zoologists and others interested in research into the problems of the Quaternary. The majority of members reside in Great Britain, but membership also extends to most European countries, North America, Africa, Asia and Australasia. Membership (currently *c.* 1100) is open to all interested in the objectives of the Association. The annual subscription is £10 with reduced rates for students and unwaged members.

The main meetings of the Association are the Annual Field Meeting, usually lasting 3 or 4 days, in April, and a 1 or 2 day Discussion Meeting at the beginning of January. Additionally, there are Short Field Meetings in May and/or September, while Short Study Courses on techniques used in Quaternary work are also occasionally held. The publications of the Association are the *Quaternary Newsletter* issued with the Association's *Circular* in February, June and October; the *Journal of Quaternary Science* published in association with Wiley, with four issues a year; the monograph series *Quaternary Proceedings*; the Field Guides Series and the Technical Guide Series.

The Association is run by an Executive Committee elected at an Annual General Meeting held during the April Field Meeting. The current officers of the Association are:

President: ***Professor F. Oldfield,*** Department of Geography, University of Liverpool, Liverpool L69 3BX

Vice-President: ***Professor J.J. Lowe,*** Department of Geography, Royal Holloway, University of London, Egham, Surrey TW20 0EX

Secretary: ***Dr. P. Coxon,*** Department of Geography, Trinity College, Dublin 2, Ireland (E-mail: pcoxon@tcd.ie)

Publications Secretary:
Dr. W.A. Mitchell, School of Geological and Environmental Sciences, University of Luton, Park Square, Luton LU1 3JU

Treasurer: ***Dr. J.E. Gordon,*** Scottish Natural Heritage, 2, Anderson Place, Edinburgh EH6 5NP

Editor, Quaternary Newsletter:
Dr. J.D. Scourse, School of Ocean Sciences, University College of North Wales, Menai Bridge, Gwynedd LL59 5EY

Editor, Journal of Quaternary Science:
Profesor M.J.C. Walker, Department of Geography, University of Wales, Lampeter, Dyfed, SA48 7ED

Publicity Officer: ***Dr. D.R.Bridgland,*** 41 Geneva Road, Darlington, Co. Durham DL1 4NE

All questions regarding membership are dealt with by the Secretary, the Association's publications are sold by the Publications Secretary and all subscription matters are dealt with by the Treasurer.

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