

November 1990 No. 62

QUATERNARY NEWSLETTER

A PUBLICATION OF THE
Quaternary Research Association

Q.N.:

QUATERNARY NEWSLETTER

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Quaternary Newsletter is issued in February, June and November. Contributions comprising articles, reviews, notices of forthcoming meetings, news of personal and joint research projects, etc. are invited. They should be sent to the Quaternary Research Association Newsletter Editor. Closing dates for submission of copy for the relevant numbers are 1 January, 1 May and 1 October.

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Printed by M1 Press Ltd., Long Eaton NG10 4HQ
☎ (0602) 732485

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ISSN 0143-2826

EDITORIAL

Dear Colleagues

Sorry!

I hope that neither the delayed publication of the last issue nor the inadvertent omission of copy inconvenienced you. However, to those who were 'put out', please accept my sincere apologies.

Thanks

I continue to receive letters in support of the vignettes and cartoons as well as those that refer to the *Newsletter* as having become a 'more friendly read'. Thank you.

BGS—mostly am!

Since the last issue, your 'friendly' editor has been kept busy, beginning in July when the site here at Keyworth (comprising the headquarters of the British Geological Survey, NERC's Isotope Geosciences Laboratory and a unit of NERC's Computing Services) was named the Kingsley Dunham Centre after Sir Kingsley Dunham FRS; this was in recognition of his distinguished contributions to the earth sciences and, in particular, to the development of the British Geological Survey between 1967 and 1975 when he was Director.

The renaming ceremony was performed by Mr Robert Jackson, MP, then Parliamentary Under-Secretary of State at the Department of Education and Science who unveiled a bronze bust of Sir Kingsley—sculpted by Mr Ken Ford. The ceremony also marked, in the 25th Anniversary year of the NERC, the completion of the Keyworth site—following the arrival there in 1976 of the first geologists from Leeds and London.

Between that auspicious occasion and a visit in September by NERC Council, NERC Institute Directors, headquarters staff and members of Advisory Board for the Research Councils, the Survey has exhibited at several venues (including the European Trade and Technology Conference at Sunderland Polytechnic and the Association for Geographic Information at Brighton) and has been visited by individuals and groups from both the UK and overseas. Several parties of school children (primary and secondary) have also been hopefully entertained and enlightened.

BGS—definitely pm!

I try to spend at least one evening a week processing Quaternary organic deposits (collected by colleagues from exposures and boreholes sites), for arthropods (mainly beetles) and hope to write up the results with Professor G R Coope before too long. Such deposits include the pre-Ipswichian cold stage fluvial Balderton Sand and Gravel of Lincolnshire and an interglacial or interstadial peat at Allt Odhar, Strathdearn, in Scotland.

The Newsletter—aims and objectives: A REITERATION

At the most recent meeting (18 October) of the QRA Executive Committee, I was exhorted to remind you of the aims and objectives of the *Newsletter* which, incidentally, has by far the largest circulation (1200 copies) of any magazine in the UK devoted to the Quaternary.

Thus, the Newsletter aims to provide a relatively quick means of communicating articles, reviews, notices and news on all matters related to the Quaternary both in the UK and overseas—hence I would welcome information on, for example, research projects, expeditions, reviews, interim reports, reports on meetings and field trips—indeed virtually anything that facilitates communication between workers in the science.

Where are you working, where are you going?—please tell me so that I relate this to others. The *Newsletter* is both for the speculative and definitive so don't be coy and introspective or wait interminably for the right moment to write that definitive article—which might be superseded by events anyway!

The *Newsletter* is *your* magazine and your principal vehicle for communicating news and views to a wide audience and on matters of both national and international importance.

Quas of the world

In *The Quaternary Perspective* (the official newsletter of INQUA), Vol. 1, No. 1/2, and *The Quaternary Times* for October 1990, a list of 'Quas of the World' unaccountably omits to mention either the Quaternary Research Association or the Irish Quaternary Research Association. Also omitted is AQUA (the Australasia Quaternary Association) which seeks to promote scientific communication between Australia and New Zealand through a twice yearly 'Quaternary Australasia'—as well as looking at the Quaternary internationally. Those interested in knowing what topics are being discussed in the antipodes might like to turn to page 00 where the contents page of the latest issue of *Quaternary Australasia* Vol. 8, No. 2 for September 1990 is reproduced.

THE QUAS OF THE WORLD (EXPANDED FROM THE INQUA NEWSLETTER VOL. 1, NO. 1/2)

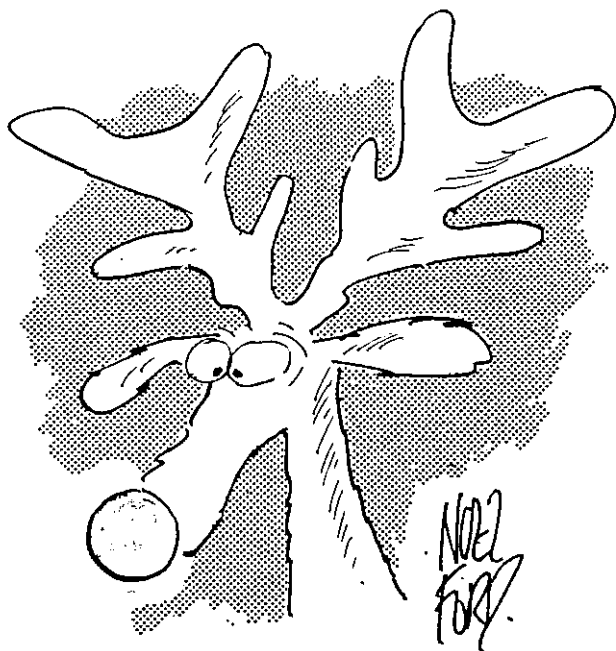
| | |
|----------|---|
| AEQUA | Association Espanhola para o Estudo do Quaternario |
| AFEQ | Association Francaise pour l'Etude du Quaternaire |
| AMQUA | American Quaternary Association |
| AQQUA | Association québécoise pour l'étude du Quaternaire |
| CADINQUA | Comite Argentino de Investigacion del Cuaternario |
| CANQUA | Canadian Quaternary Association |
| DEUQUA | Deutsche Quartarvereinigung |
| GTPEQ | Grupo de Trabalho Portugues para o Estudo do Quaternario |
| INQUA | International Union for Quaternary Research |
| SASQUA | South African Quaternary Association |
| S-QUAT | Schweizer Quartargruppe-Groupe Suisse du Quaternaire-Gruppo Svizzero di Quaternario |

Incidentally, the Oxford English Dictionary lists 'quas' as a variant of kvass which is a fermented beverage commonly made from an infusion of rye-flour or bread with malt (i.e. rye bread) and in general use in Russia—just thought you'd like to know!

As this is the last issue before Christmas and the New Year, may I take this somewhat premature opportunity to wish all readers of the *Quaternary Newsletter* and all members of Quas throughout the world a joyful Christmas and a peaceful and prosperous New Year.

P.S. Following polite requests from several members the type size of future issues will be increased!

~~~~~



Father Christmas  
I've recently read  
Has averred his aversion  
to lead  
So now, I suppose  
Poor Old Rudolph's red nose  
Will be changed for a green one  
instead

Cartoon reproduced by kind  
permission of Noel Ford, Nuneaton, UK

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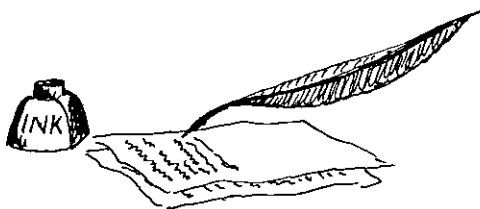
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# Articles & Notes



## A PRELIMINARY INVESTIGATION OF COASTAL DEPOSITS AT NEWTON CARR, WIRRAL, MERSEYSIDE

J B Innes, D J Bedlington, R J B, Kenna and R W Cowell

### Introduction

The sequence of unconsolidated sediments in the coastal lowlands adjacent to Liverpool Bay have been the subject of scientific interest for well over a century (Reade, 1871; de Rance, 1871). These early investigations were carried out by geologists whose attentions were focused upon the stratigraphic relationships and distribution of these sedimentary units as evidence for relative uplift or subsidence of the landmass since the end of the last glacial period. An extensive early literature therefore exists, particularly in the Proceedings of the Liverpool Geological Society, upon which modern workers have been able to base systematic research projects which seek to explain these coastal deposits in terms of the sedimentary environments and processes of palaeoenvironmental change which they represent. The Liverpool Bay coastal zone has therefore formed a major field area for the study of Holocene relative sea-level change, as have other parts of the coast of north-west England. Tooley (1978, 1982, 1985) has recorded complex coastal lithologies in the south-west Lancashire part of the area, comprising intercalated clays, silts and peats which he has been able to ascribe to marine, estuarine, freshwater or terrestrial origin by detailed pollen and diatom analysis. These lithological changes reflect radical differences in local depositional conditions which can be interpreted as being consequent upon the introduction or withdrawal of marine conditions. This process may result from, for example, regional changes in sea-level or from very local changes in the morphology of coastal landforms such as barrier breaches (Gerrard, Adlam and Morris, 1984). Whatever the cause, however, radiocarbon dating and altitudinal correlation of the contacts between lithological units has allowed their use as index points in the creation of transgressive and regressive overlap sequences (Shennan, 1983), from which it may be possible to induce positive or negative regional tendencies of sea-level movement (Shennan *et al.*, 1983).

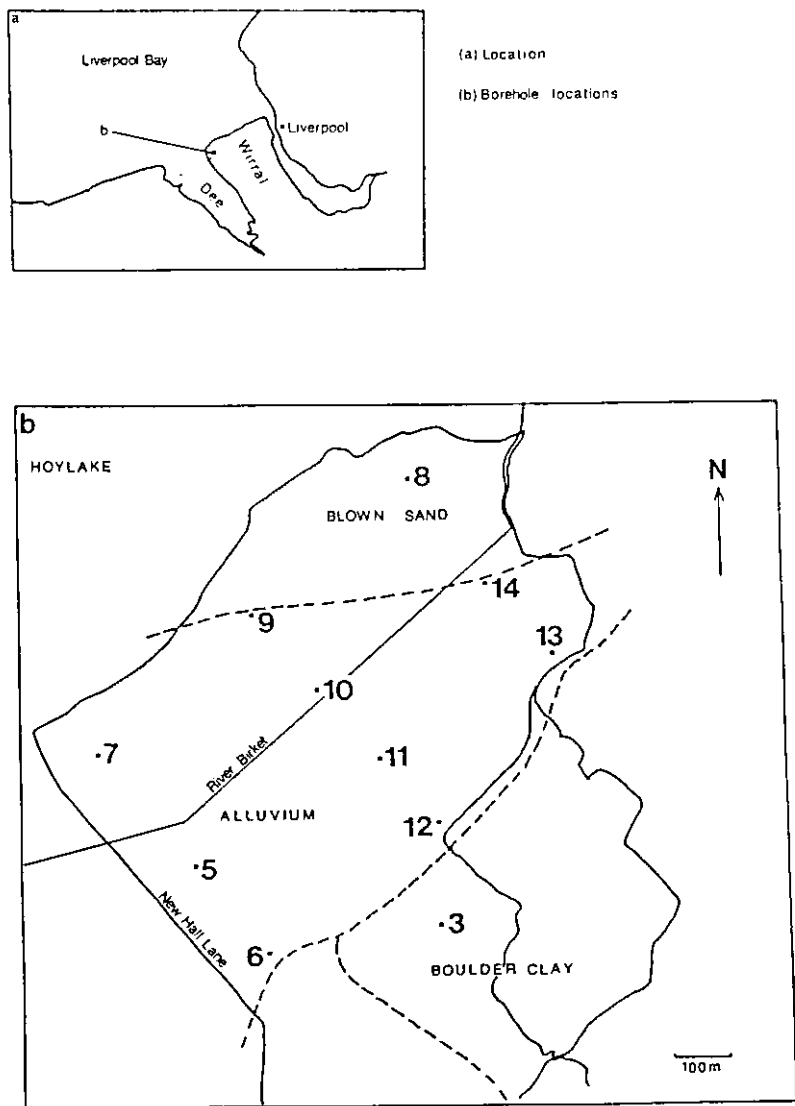
Tooley (1978, 1985) has interpreted a series of such sea-level index points from Downholland Moss in south-west Lancashire as recording several regionally significant movements in sea-level during the Holocene. Such regionally significant events should be broadly relateable to events in other parts of the south and east coasts of the Irish Sea. Differences in influencing factors such as coastal morphology, palaeotidal amplitudes and local rates of isostatic readjustment in different parts of the Irish Sea basin, however, mean that the effects of any regional Holocene sea-level adjustments will have been manifest differently across relatively short distances. The IGCP recommendations (Pirazolli, 1987) for future studies of sea-level history stress the need for local investigations to promote intra-regional comparisons.

Kenna (1986) has assembled a comprehensive body of lithostratigraphic, palaeoenvironmental and radiocarbon data from the coastal zone of north Wirral, Merseyside. These data show that the coastal sediments of Wirral contain a record of mid-Holocene sea-level changes as rich as those noted in south-west Lancashire. They provide an ideal opportunity for correlation of data within the southern Irish Sea basin by the establishment of a local sequence of index points, forming a link between the Lancashire evidence and studies in north Wales into sea-levels (Manley, 1981; Prince, 1988) and sea-levels and neotectonics (Bedlington, in prep.).

### Newton Carr, Hoylake

In this paper we report the preliminary results of stratigraphic and palaeoecological investigations at the site of Newton Carr which lies to the south of Hoylake in north-west Wirral, about a mile from the

# NEWTON CARR



**Figure 1** Location of the site and distribution of the boreholes at Newton Carr, Hoylake.



current coast (Figure 1). This work provides a context for a wider research project into the Late Quaternary archaeological (Cowell a and b) and palaeoenvironmental history of the north Wirral coastal zone, which has the aim of reconstructing its complex palaeogeography and landscape evolution.

The sedimentary record at Newton Carr is of particular interest because the site occupies one of a number of buried channels and depressions in the pre-Holocene surface (Kenna, 1986), in this area a red, stony boulder clay derived from the local sandstone succession. Although this glacial drift surface is generally undulating, so that minor topographic features are common in the area, in the major channel features the pre-Holocene surface lies several metres below ground level, so that within them are preserved long sequences of intercalated Holocene peats, clays and silts. The major depression in which Newton Carr lies, termed the 'western depression' by Kenna (1986), is not well surveyed owing to a lack of borehole logging data. It seems to occupy all of the area between Hoylake and West Kirby, however, dipping sharply to the west and south-west with the subsurface at -7 m OD south of Hoylake. The sides of this depositional basin seem from the limited borehole data to be relatively steep to the east and south, but it is quite probable that the depression continues to deepen to the west and north west. It could well have formed a shelving coastline directly open to the sea in these directions during the major Holocene eustatic sea-level rise, and so the deep sediments accumulated within it could well provide an accurate record of transgressive and regressive events, avoiding the complex local sedimentation regimes of deeply incised buried river channels elsewhere on this coast. Further fieldwork data are required to establish the morphology of the western part of the basin.

### Lithostratigraphy

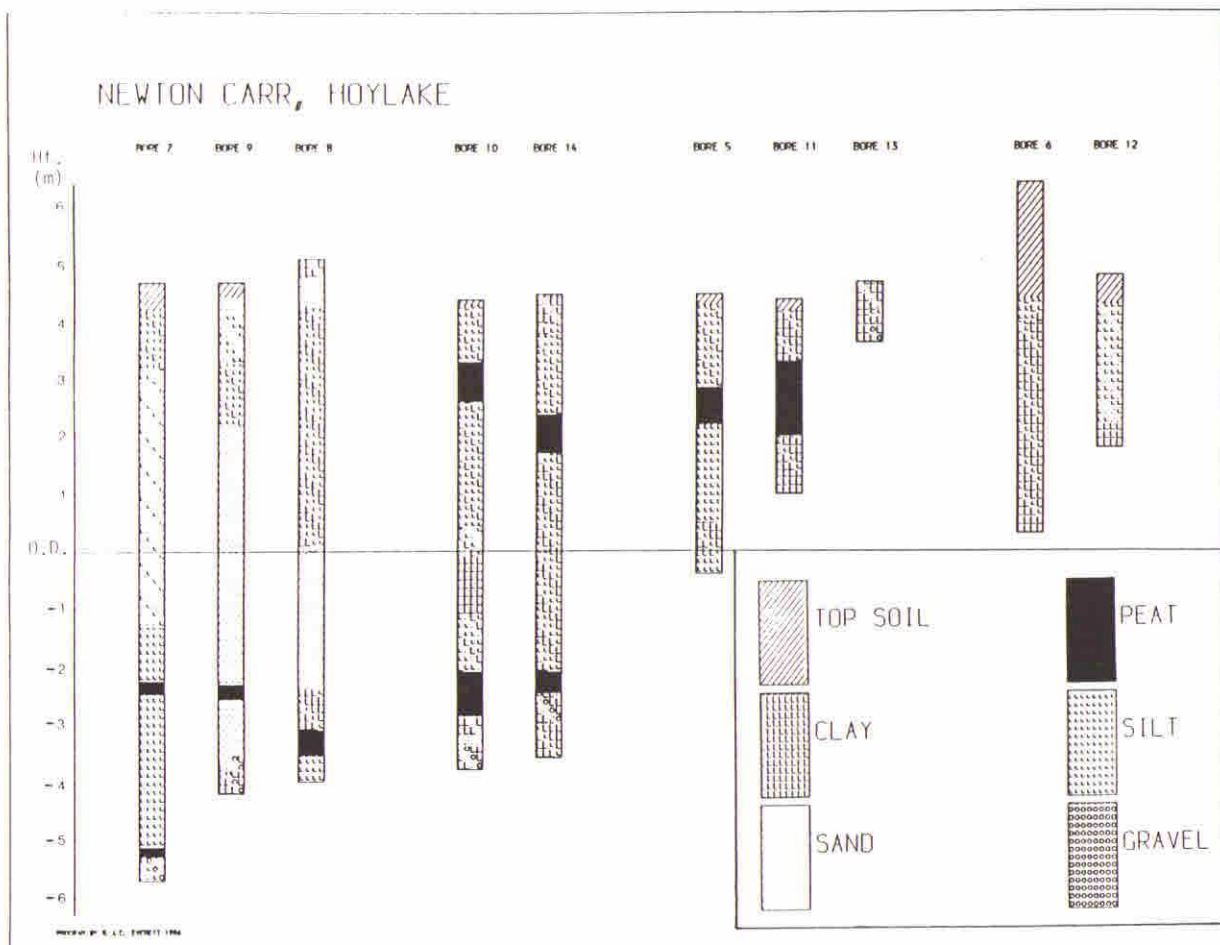
The location of boreholes in the Newton Carr depression are shown in Figure 1 and the lithostratigraphic data are displayed in Figure 2. The deepest sediment which is certainly of Holocene age is a thin, highly compacted, peat with small wood fragments which rests upon a pebbly sand above red boulder clay at an altitude of -5.3 to -5.1 m OD in the most westerly borehole, number 7. It has not yet been recorded elsewhere at the site. It is overlain by a cohesive blue-grey silt which gives way to a second thin peat between -2.45 and -2.25 m OD. Peat is also present at this level in boreholes 8, 9, 10 and 14. In bores 8 and 9 this peat overlies silts and sands, in the latter case the peat being somewhat ephemeral within the sand horizon. In the case of bores 10 and 14, however, the peat rests upon pebbly clay which clearly represents the surface of the pre-Holocene drift. As with the lower peat in bore 7, these two strata are basal peats which allow the recognition of the rising pre-Holocene surface towards the south-east rim of the basin.

This peat layer of intermediate altitude is in all cases overlain by clayey silts or silty sands, the sandier facies predominating in a seaward direction, in bores 7, 8 and 9 towards the deeper part of the depression. The clayey silt facies of this unit is also recognisable in the next transect of bores to the south, numbers 5, 11 and 13, where it lies, however, directly upon the pre-Holocene boulder clay surface. There seems to be a considerable break of slope between this line of transect 10 to 14 and transect 5 to 13, the altitude of the pre-Holocene rising from about -3 to about +1 m OD over a distance of only 100 metres. The edge of the depression feature itself may lie between these two transects, the gradient from this point landward being relatively shallow. No basal peats are recorded in, or upslope from, transect 5 to 13.

Resting upon this clayey silt facies is an upper peat horizon which appears only in the central part of Newton Carr, being present in bores 10, 14, 5 and 11. In the northerly transect 7, 9 and 8 clays, silts and sands continue to the surface, whereas in the more southerly transects, 6 to 12 and beyond, clays or the pre-Holocene landsurface are present at this altitude. This upper peat layer may be regarded as synonymous with the Upper Peat and Forest Bed of earlier workers (de Rance, 1871; Morton, 1897), although Kenna (1979, 1986) suggests that this unit may further be subdivided into a forest bed and an upper peat which are separated in places by a clayey peat or thin silty clay. At Newton Carr this peat layer seems to contain little wood, macrofossils being restricted mainly to *Phragmites* rhizomes, and averages about a metre in thickness.

An upper deposit of alluvial silty clay covers the upper peat bed where it exists in the central part of the site, forms the upper facies of the minerogenic succession in bores 7, 9 and 8, and laps over the pre-Holocene surface in bores 6, 12 and 13 where it forms the most landward extension of the Holocene sediment sequence which fills the Western depression. To the south and east of these points, the

Figure 2 Lithostratigraphy at Newton Carr.



boulder clay drift outcrops at the surface at altitudes above about +5 m OD. The silty clay succession at bore 8, which elsewhere is exposed at the surface, is covered by a thin sheet of blown sand, being the landward limit of the Late Holocene dune system which occupies the north Wirral fringes from West Kirby on the Dee to New Brighton on the Mersey.

### Interpretation

Inspection of the lithostratigraphic data presented in Figure 2 suggests that the biogenic deposits in the Newton Carr basin may be divided into three discrete stratigraphic units with discrete altitudinal limits. This appears to be true when basal as well as other peat layers are considered, although it remains to be seen whether additional borehole information might blur the present altitudinal distinction. At present, however, the tripartate nature of Newton Carr peats is suggested by the data, and they represent three periods of terrestrial and freshwater depositional environments. These three peat deposits are shown, with their apparent altitudinal limits, on Figure 3 which summarises the environmental record at Newton Carr as presently known. It is suggested that these differences in the character and altitudes within each of the three peat strata between individual boreholes will be due to a combination of topographical, chronological and local environmental factors.

| m<br>OD | Lithology                  | Pollen Analysis                          | Approx.<br>Age BP | Chronozone |
|---------|----------------------------|------------------------------------------|-------------------|------------|
| +3.2    | Upper<br>Marine<br>Facies  |                                          | c.5000            | F III      |
|         | Upper<br>Peat              | NC11-d<br>NC11-c<br>NC11-b Quercus-Alnus |                   |            |
|         |                            | NC11-a Quercus-Ulmus<br>Alnus            |                   |            |
| +1.5    | Middle<br>Marine<br>Facies |                                          | c.7200            | F II       |
| -3.0    | Middle<br>Peat             | NC7-c Quercus-Ulmus<br>NC8-a Alnus       |                   |            |
| -3.5    | Lower<br>Marine<br>Facies  |                                          |                   |            |
| -5.1    | Lower<br>Peat              | Nc7-b Quercus-Ulmus<br>Alnus             |                   |            |
| -5.3    |                            | NC7-a Quercus-Pinus                      |                   | F I        |

Figure 3 Summary of the environmental record at Newton Carr.

In order to clarify the age and palaeoecology of the peat strata, preliminary pollen analyses have been conducted on representative profiles from three boreholes, numbers 7, 8 and 11. Two pollen assemblage zones occur in the Lower Peat stratum in core 7, the first (NC7-a) characterised by *Quercus* and *Pinus* pollen and the second (NC7-b) by pollen of *Quercus*, *Ulmus* and *Alnus*. The decline of pine and rise of alder in this basal peat at core 7 is considered to be the boundary between Chronozones Flandrian I and Flandrian II (Boreal-Atlantic transition) and is dateable by reference to other pollen diagrams in north-west England (Hibbert, Switsur and West, 1971) to shortly before 7000 BP. The single pollen assemblage of the thin peat layer of core 8 (NC8-a), representing the 'Middle Peat' stratum, is dominated by *Quercus*, *Ulmus* and *Alnus*, as is the peat of similar altitude from core 7 (NC7-c). Both are dateable to within Chronozone Flandrian II, although a closer age is not yet possible. The 'Upper Peat' stratum at core 11 contained four assemblage zones: NC11-a dominated by *Quercus*, *Ulmus* and *Alnus*, NC11-b by *Quercus* and *Alnus*, NC11-c by *Betula* and NC11-d by *Alnus*. The decline in elm pollen between NC11-a and NC11-b forms the Flandrian II-III transition and is dateable (Hibbert, Switsur and West, 1971) to about 5000 BP. This would agree with the age of the Upper Peat and Forest Bed at other locations in Wirral (Kenna, 1986). Zones NC11-b, NC11-c and NC11-d are thus all of Flandrian III age and the pollen changes between them must reflect changes in local successions governed by hydrological conditions.

The approximate ages of the three minerogenic facies (termed Lower, Middle and Upper in Figure 3) which intercalate the three peat strata may also be inferred from the pollen data. The pollen flora from peat levels at each of the peat-clay contacts also yield data regarding the local environment at the times of change from biogenic to minerogenic sedimentation and *vice versa*. At each of the five such contacts significant frequencies of Chenopodiaceae pollen, and the presence of other saltmarsh indicators such as *Armeria*, *Artemisia*, *Plantago maritima* and *Aster*-type, suggest that the silt and clay facies are estuarine or marine in origin. This is confirmed by the presence of marine and brackish-marine diatoms in the silty clays near the contacts such as *Diploneis interrupta*, *D. incurvata*, *Triceratum favus* and *Coscinodiscus* sp., and by the presence of valves of *Scrobicularia plana*, *Cardium* and *Tellina baltica*, particularly in the upper silty clay facies overlying the Upper peat.

## Conclusion

The lithostratigraphic evidence from Newton Carr therefore represents at least three periods of biogenic accumulation under terrestrial conditions and three episodes when the direct influence of marine-estuarine conditions expanded across the whole site and blue-grey silty clays were laid down. The site has thus provided five transgressive or regressive overlap contacts which can serve as sea-level index points from which tendencies of sea-level movement on this coast in the mid-Holocene may be inferred. It may be that further borings will reveal deeper peats to the west of the current boreholes, as the pre-Holocene subcrop seems to continue to decline in that direction.

Comparison of the Newton Carr sequence with data from other sites already studied in south-west Lancashire and currently under examination in north Wales requires considerably more research than exists at present. In particular more precise information, through the radiocarbon dating of contacts and a much expanded programme of borings, must be collected, which will also be used as the basis of subsequent archaeological investigations, and such research will be undertaken by the authors in the near future. It is as yet not possible to say whether the Newton Carr sequence represents the regional Holocene sea-level trend in Liverpool Bay, or whether some contacts may represent the effects of the building or breaching of temporary near-shore barrier landforms. Current evidence does not support the idea that barriers were a feature of the mid-Holocene geography of the Wirral coast. The flat nature of the near-coast submarine plain at this location, although seismic investigations have revealed high points in the offshore boulder clay towards the eastern end of the Wirral coast (Kenna, 1986), supports this. Also, the pollen record for aquatic and other taxa indicative of different hydrological environments shows evidence of stable succession through saltmarsh, reedswamp, fen and carr communities in the Newton Carr peats which suggest gradual movements of groundwater levels in lagoonal and perimarine situations, rather than the more abrupt alteration of conditions to be expected with a dynamic breaching event. It would seem that, perhaps more so than other sites on the Wirral coast, the sediments in the Newton Carr depression may yield a representative record of early and mid Holocene sea-level movements in southern Liverpool Bay, especially if a succession of basal peats at various, but

particularly at increasingly lower altitudes may be isolated and dated. More empirical data are required, however, and future research will be directed to this end.

### Acknowledgements

We are grateful to the North West Water Authority for access to borehole records, and to the land-owners at Newton Carr for fieldwork permission.

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## GLACIAL REFUGIA IN SOUTH GEORGIA? PROTOZOAN EVIDENCE

David M Wilkinson

In a discussion of glacial refugia in *Quaternary Newsletter* No. 58, Buckland and Dugmore (1989) suggested that had there been no refugia on the sub-Antarctic island of South Georgia, its biota must have colonised the island during the Holocene and should therefore be a subset of the biota of southernmost South America. Conversely, if refugia had existed, then endemic species might be expected to occur in South Georgia. Buckland and Dugmore (1989) suggested that the beetles of South Georgia were almost certainly a subset of South America, suggesting a lack of refugia. The aim of this note is to present relevant data on the testate amoebae genus *Nebela* for South Georgia.

Testate amoebae differ from other members of the Rhizopoda in their ability to form a shell; they have been very successful in colonising the Antarctic with 21% of testacean genera occurring there (Decloitre and Calleux, 1980). They are large for microorganisms, being typically 50–150 µm long and with a fresh weight of 50–500 pg. They are found in both terrestrial and fresh water habitats characterized by substrates with a high organic content and slow rates of decomposition (Smith and Wilkinson, 1987). The biogeography of the genus *Nebela* south of 40°S, has been studied by Smith and Wilkinson (1987) and Wilkinson (in press) using a presence/absence matrix compiled by reviewing the published surveys of testacean faunas from the earliest southern records (Certes, 1891) up to 1986. Full details of the compilation of this matrix were given by Smith and Wilkinson (1987). The relevant parts of this data set are reprinted as Table 1.

**Table 1** The occurrence of members of the genus *Nebela* on South Georgia and Marion Island

| Species                                 | South Georgia | Southern Chile | Marion Island |
|-----------------------------------------|---------------|----------------|---------------|
| <i>N. playfairi</i>                     |               | +              | +             |
| <i>N. playfairi</i> var <i>elongata</i> |               |                | +             |
| <i>N. playfairi</i> var <i>lata</i>     |               |                | +             |
| <i>N. dentistoma</i>                    | +             | +              | +             |
| <i>N. trers</i>                         |               | +              | +             |
| <i>N. antarctica</i>                    |               |                | +             |
| <i>N. collaris</i>                      | +             | +              |               |
| <i>N. tinca</i>                         |               | +              | +             |
| <i>N. wallsei</i>                       | +             | +              | +             |
| <i>N. vas</i>                           | +             | +              | +             |
| <i>N. certesi</i>                       |               | +              | +             |
| <i>N. martiali</i>                      | +             | +              | +             |

**Notes:** *N. antarctica* and the two varieties of *N. playfairi* appear to be unique to Marion Island.

Only species from southern Chile which occur on either South Georgia or Marion Island are shown. The fauna of southern Chile is much larger with 31 species being recorded.

From the table, it can be seen that the *Nebela* fauna of South Georgia forms a subset of the fauna of southern Chile. By comparison, the fauna of Marion Island (latitude 46°50'S compared with South Georgia 54°20'S) contains a number of endemics. This suggests a lack of glacial refugia on South Georgia since organisms the size of *Nebela* would require relatively simple conditions (e.g. a patch of bryophytes) for survival. The endemics of Marion Island are likely to have evolved during the Quaternary since it is a recent volcanic island, being about 500 000 years old (Verwoerd, 1971).

The most likely means of colonisation of South Georgia by *Nebela* is as windborne particles from areas which were ice-free during the last glacial maximum; these species form cysts with a weight of the order of  $54 \times 10^{-6}$  mg (Decloitre, 1954) which could be wind transported. In this context, it is interesting to note that tree pollen from South America has been collected on South Georgia (Barrow, 1978).

### Acknowledgements

My work on *Nebela* has benefited greatly from collaboration by, and arguments with, Humphrey Smith of Coventry Polytechnic.

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## EVIDENCE FOR TREE GROWTH DURING THE UPTON WARREN INTERSTADIAL IN GLOUCESTERSHIRE, ENGLAND

P F Whitehead

**Abstract:** Evidence, albeit very limited, indicates that trees survived the Upton Warren Interstadial of the last glacial near Cheltenham, Gloucestershire. Belonging to the family Pinaceae, they probably occurred in relict pockets on the Cotswold scarp-slopes.

**Introduction:** The sands and gravels in the area of Wingmoor Farm, Gloucestershire, have been worked for at least 30 years, but the intensity of commercial extraction is now declining. On 9 February 1990 I was examining a section at SO 940275 (40 m OD) in which exactly 1 m of sand and gravel was bottomed, passing down into Lower Lias Clay. Two lenses of black organic silt were visible at the contact of the gravel and clay, and these were sampled in the field. They contained molluscs, a fragment of an upper tooth of Woolly Rhinoceros, (*Coelodonta antiquitatis* Blum.), and to my amazement, a piece of exfoliated bark measuring 50 × 30 mm, from a mature gymnosperm. Three species of mollusc were represented: *Succinea oblonga* Drap. var. *elongata* Sandberger, *Anisus leucostoma* (Millet), and the normal form of *Pisidium obtusale* (Lamarck).

**The age of the Cheltenham Sands and Gravels:** These 'Cotswold Delta Fan Gravels' have been correlated (Tomlinson, 1935; Briggs, 1984) with the Main Terrace (syn. Beckford Terrace) of the Carrant Brook, and by implication with the Main Terrace of the Severn and No. 2 Terrace of the Avon. This is regarded as proven by a 14C date obtained from plant material isolated from a similar organic lens at Wingmoor Farm during 1984 (32 000 BP: Birm-1205), and by a 14C date (26 600 BP: Birm: 656) recently obtained (Whitehead, 1979) on a *Bison* sacrum from Broadway, Worcestershire, found in 1915.

**Climate and environment during the formation of the Cheltenham Sands and Gravels:** Briggs (1984) has postulated that the Cheltenham Sands and Gravels aggraded in a harsh, open, treeless environment, the sand having been winnowed from the Main Terrace of the River Severn. Faunal evidence for climate and environment is derived from the Woolly Mammoth–Woolly Rhinoceros–Reindeer large mammal fauna (Whitehead, see following paper), and the presence of pollen of *Koenigia*, (Briggs, 1984) a boreo-alpine herb. *Succinea oblonga elongata* is a hygrophilous gastropod evidently confined to loess-like sediments in arid, open landscapes. The general environment is undoubtedly of "full-glacial" type.

**Tree-growth and the environmental background:** The contemporaneity of the bark, crucial to the discussion, can be established summarily. Gentle rinsing of the bark exposed frass-filled galleries produced by the larva of a scolytid beetle; had the bark been subject to extended, or multiple cycles of derivation, the frass would have been removed. It is a hallmark of Quaternary palaeobotany that large trees were absent from the midland England during the Upton Warren Interstadial. Although the sum total of work in riparian and lowland situations does, as far as I am aware, militate against the presence of trees at that time, this matter may now require review. Isolated relict pockets of trees may have survived on the higher Cotswolds or hill valleys, or on inaccessible rock faces, e.g. Cleeve Hill, between 300–400 m OD.

**The identity of the tree:** The bark is from either a pine (*Pinus*) or spruce (*Picea*). Whilst its specific identity is not crucial to the discussion, I have compared it with outer-bark fragmentation patterns of mature *Pinus sylvestris* L. and *Picea abies* (L.) Karst. and refer it to *Picea*.

**The identity of the scolytid beetle:** The specimen was submitted to Dr M L Cox at NHM for comparison with larval gallery collections. He was unable to ascribe the galleries unambiguously to their causal organism, but concluded that *Tomicus (Blastophagus) piniperda* (L.) was a clear candidate. I collected modern samples of *Picea* bark heavily infested with *T. piniperda* larvae from Worcestershire, and found close correlation. The adult exit holes are identical in size and taper upwards identically.



*T. piniperda*, recorded by Morgan (1973) in her Devensian pre-Upton Warren interstadial group 1 fauna from Four Ashes, Staffordshire, is the most likely scolytid colonist in the present case.

**Conclusion:** Relict pockets of gymnosperms, probably *Picea*, persisted on the Gloucestershire Cotswolds during the late mid-Devensian. Pollen viability was doubtless suppressed. By about 30 000 BP the trees may have been largely moribund, sometime after which climatic events would have entirely extinguished them.

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## THE VERTEBRATE FAUNA OF THE CHELTENHAM SANDS AND GRAVELS

**P F Whitehead**

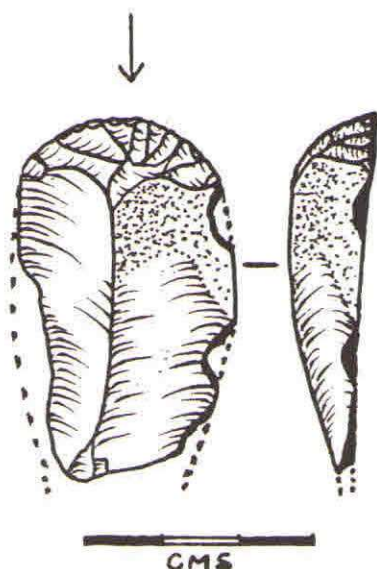
**Introduction:** Remains of vertebrates have always been regarded as rare in the Cheltenham Sands and Gravels. The earliest material that I am aware of dates from about 1965, and an upper tooth of horse (*Equus* sp.) is in Cheltenham Museum.

On 14 occasions between 1981 and 1987, near Wingmoor Farm, Bishop's Cleeve, Gloucestershire, I located remains of vertebrates in or from the gravels. The 10 km grid reference is SO 92.

**The skeletal material:** 43 items have been recovered of which 7 are indeterminate. 28 (78%) of the remaining 36 are teeth. A fragmentary ulna of a Woolly Mammoth (*Mammuthus primigenius* Blum.) and the frontal bones of a bison (*Bison* cf. *priscus* Boj.) were found *in situ* in laminated silty clay immediately beneath the gravels.

**The faunal spectrum:** Remains have been assigned to vertebrates in the following proportions:

|                                      |       |
|--------------------------------------|-------|
| Elephantidae                         |       |
| <i>Mammuthus primigenius</i> (Blum.) | 27.8% |
| Rhinocerotidae                       |       |
| <i>Coelodonta antiquitatis</i> Blum. | 37.8% |
| Equidae                              |       |
| <i>Equus sp.</i>                     | 16.6% |
| Cervidae                             |       |
| <i>Rangifer tarandus</i> L.          | 2.8%  |
| Bovidae                              |       |
| <i>Bison</i> cf. <i>priscus</i> Boj. | 15.0% |



This fauna can be dated by a  $^{14}\text{C}$  date of 32 000 BP (Birm-1205) made on plant material from an organic lens beneath the gravels located at SO 941273 on 1 March 1984. The mammal fauna, demonstrating an open, herb-dominated productive environment is entirely typical of the time. *Equus spelaesus* Owen is the oldest name that can be applied to the West Palaearctic Wild Horse. The diagnostic cranial bones required for positive identification of *Bison priscus* were not available, but there can be little doubt that this is the species concerned. It was an intensely gregarious open-country bison that preferred warm-temperate grasslands, but which persisted into the late mid-Devensian in Britain.

*Palaeoliths*: Human artefacts are limited to one; an end-of-blade scraper (Fig. 1) found *in situ* at SO 944268 on 30 July 1981. This battered artefact was found 65 cm deep in gravels 190 cm thick beneath 85 cm of loam. Not only is it therefore securely dated to the formation of the gravels, but it would certainly not be out of place in the Upper Palaeolithic. The  $^{14}\text{C}$  date of 32 000 BP may reflect directly on it.

Lack of topographic shelter appears to have made the general area unattractive to man and the megafauna, at least in relation to other regional sites.

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## CATASTROPY AND THE GOLDFISH

By Knut Fægri

In "Garden rubbish", Sellar and Yeatman describe a derelict bathtub found in a suburban garden with a goldfish swimming around in eternal fright of the plug being pulled.

In their laudable attempt to clarify the meaning of that over-used term catastrophic, Maizels and Russel (QN, No. 61, 12-22) neglect a very important facet of the problem, which is beautifully illustrated by the quotation above: what would be catastrophic for the goldfish would be an extremely trivial event for the person who pulled the plug.

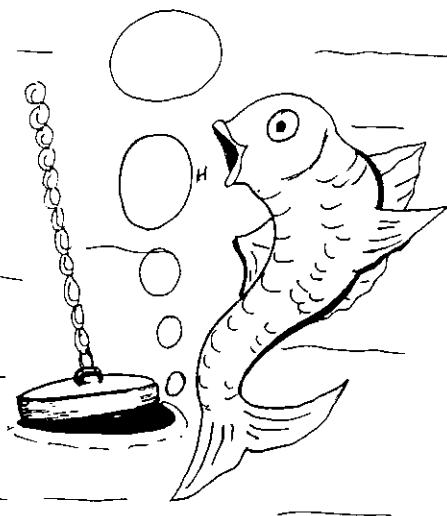
The concept catastrophe and catastrophic are relative. They only exist in relation to a previous, defined or inferred, situation that is considered stable in relation to relevant parameters. A violent rainstorm may be a catastrophe for a lady in a summer dress or for an ephemerid caddis, the habitat of which is destroyed, but it would hardly be noticed by a sedimentologist who studied that deposit. He would need a *hjókulhláup* to sense a similar catastrophe.

However desirable, it is not possible to define a catastrophe in general terms, not even with the narrow concepts of e.g. Quaternary studies. The most important characteristic of a catastrophe is that it is destructive in relation to a previously existing (semi-stable) condition. Regular cycles of sediment accumulation and denudation do not in themselves constitute catastrophes, since the cycle in itself is a semi-stable condition. But it may have catastrophic, annihilating effects on particular habitats inside the cycle.

In addition to its destructiveness, a catastrophe is usually unexpected and swift, of short duration, usually momentous in relation to the relevant timescale. The Ice Age had catastrophic effects on the biota of NW Europe, but in itself it cannot be called a catastrophe simply because of its long duration. Incidentally, it was also cyclic.

The eruption of Mount Vesuvius in 71 AD was a genuine, general catastrophe: unexpected, swift and destructive across a large area. The bubbling cauldrons of Hawaiian volcanoes are not catastrophic in themselves, but the occasional lava streams certainly are so in relation to stable biotopes.

The consequence of this view is that the concept of a catastrophe cannot be applied in a general sense without qualifications: the premises both in time and in space must be defined/inferred/agreed by common consensus. The deleterious effects are always implied, but also here we must define for whom. Today's archaeologists may have a different opinion about the Vesuvius eruption than did the inhabitants of Pompeii.



# STUDIES OF NON-DIRECTIONAL MAGNETIC PROPERTIES OF CHINESE LOESS AND PALAEOOLS:

## A Report to the QRA Research Grants Subcommittee

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The particular attraction of Chinese loess is its potential for palaeoenvironmental studies. One means of retrieving palaeoclimatic information from a loess sequence involves measurements of non-directional magnetic properties of loess and intervening palaeosols. It has been found that magnetic susceptibility is significantly higher in palaeosols than in loess (Heller et al., 1986). This observation has been explained in terms of depositional dilution assuming a constant influx of magnetic particles from remote, but unidentified sources (Kukla, 1987). However, studies have shown that pedogenic production of secondary ferrimagnetic minerals is widespread (Maher and Taylor, 1988). If the secondary magnetic minerals can be preserved through geological time, they should be detectable by means of mineral (rock) magnetic measurements and could be useful for Quaternary studies. Conversely, the non-existence or destruction of the magnetic minerals of secondary origin may be of equal interest for their sedimentary and palaeoenvironmental implications.

At the first stage of the project partially supported by a QRA Award (£60) to Young Quaternary Research Worker in 1988, I carried out a survey of the mineral magnetic properties of Chinese loess and palaeosols to test the depositional dilution interpretation and to examine the possible existence of pedogenic magnetic minerals preserved in Chinese palaeosols. A range of magnetic parameters in addition to low field magnetic susceptibility were measured. The results, as summarised in the report to QRA in January 1989, have led to the proposition that magnetic susceptibility enhancement encountered in Chinese palaeosols is, at least in part, attributable to the formation of fine-grained secondary ferrimagnetic minerals.

The investigation continued in 1989. This involved more magnetic measurements in order to demonstrate the new applications of mineral magnetic techniques in loess and palaeosol studies. Frequency-dependent magnetic susceptibility again proves to be very useful for these sediments. With interparametric quotients (cf. Thompson & Oldfield and Maher), the effects of concentration are suppressed and variations in mineralogy and particularly in grain size of magnetic components are revealed. This approach was employed to characterise magnetic phases of different origins. Results obtained confirmed the previous inference on the presence of pedogenic ferrimagnetic minerals in palaeosols and perhaps in some loess samples. It is concluded that the secondary ferrimagnets are, to a large extent, responsible for the observed magnetic enhancement in the palaeosols. It is shown that the formation and preservation of these magnetic minerals in relatively homogeneous sediments, like loess, have significant implications for palaeoenvironmental reconstruction. When combined with other proxy data, the fluctuations in non-directional magnetic signatures in loess and palaeosols may be used to infer changes in the past hydrological regime, vegetation cover and perhaps wind patterns, e.g. wind strength and monsoon circulation. Nevertheless, more quantitative studies are required to evaluate this post-depositional enhancement or more specifically pedogenic model for the magnetic variations in Chinese loess sequence.

Part of the results arising from this work was presented at the QRA Discussion Meeting (January, 1989); the 5th EUG in Strasbourg, France (March, 1989) and the Edinburgh symposium on 'The late Cenozoic ice age' (July, 1989). This work forms part of my research supervised by Dr A G Wintle. A grant (£75) from the QRA was obtained in 1989 to cover travel and other costs in order to conduct experimental work in Liverpool. I acknowledge the QRA for support. I wish to thank Professor F Oldfield for giving me access to the magnetic facilities in the Geography Department, University of Liverpool, R Jude for laboratory assistance and Dr Lizhong YU for scientific and logistic help during my stay in Liverpool.

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## PROXY CLIMATIC RECORDS AND FUTURE CLIMATIC CHANGE

### A commentary on priorities for research into Palaeoclimates of the last Glacial/Interglacial cycle

The gap between Milankovitch scale ( $10^3$ – $10^5$  years) and the shorter term changes in climate detectable from meteorological records ( $10$ – $10^2$  years) is of great importance in understanding current climatic changes and in predictive climatic modelling. We argue that research into Holocene climatic changes on a  $10^2$ – $10^3$  year time scale is required to fill this gap.

For time periods before the beginning of meteorological records (before the 17th Century AD), climatic changes can be detected by inferring their effects on environmental systems via proxy data sources. The use of a variety of different and overlapping data sources can yield indirect observations of climate. Combining those observations allows the reconstruction of past climatic change.

Increasing awareness of past climatic changes, causes and effects, leads to the possibility of modelling, and thereby predicting, future patterns. The possibility of current climatic change is of international scientific and political concern, suggesting a need for predictive models of future trends that adequately account for 'natural' variability. Proxy data can provide information applicable to predictive modelling on a variety of timescales.

Research through proxy data has shown the off-shore connection between sediments and palaeoclimate, confirming long-term climatic variability. The various periodicities predicted by the Kroll-Milankovitch equations have been traced in isotopic and species assemblage analyses. Long term predictions regarding future climatic change can be made on this basis, given due consideration of remaining unknowns and anthropogenic effects.

The Holocene is the time period which includes current climate. It is the best represented time period in terms of the palaeoenvironmental record, and the period in which man has been influenced by, and may now be causing, climatic changes.

Research into the current interglacial is that most likely to yield proxy data applicable to the requirements of those investigating future trends. Changes can only be attributed to man if the changes prove to be different in scale and direction from those predicted from analysis of the past record of climate. The time scale of  $10^2$ – $10^3$  years can best be investigated by using proxy climatic records from the Holocene.

This could give Quaternary Palaeoclimatology a predictive role on the medium scale of climatic change.

NERC has established a major Special Topic programme on Palaeoclimates of the last glacial/interglacial cycle and has recently announced its first awards under this scheme. At the Community Meeting in February 1990 the importance of research into Lateglacial climatic switching was emphasised, as a possible analogue for future, abrupt climatic instability. Equally abrupt changes, though of lesser amplitude, appear to have taken place within the Holocene.

If research into past climates is intended to advance from the establishment of the past record, towards providing data for use in predictive modelling, then the Holocene is as worthy of equal representation as earlier time periods. We suggest that research into establishing the pattern of Holocene climatic change should figure prominently in the research strategy of the Palaeoclimates Special Topic.

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## THE MORAINES OF CWM IDWAL: CORRECTION AND COMMENT

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Due to a typographic error on page 95 of the North Wales Field Guide (Addison et al., 1990), I am now in print as possibly supporting an interpretation of the Idwal moraines, that I do not in fact favour. I therefore wish to correct the published record, and to take this opportunity of reporting some of the discussion of the features that took place during the Annual Field Meeting in April.

The copy I submitted to the Guide editors read as follows:

"Much of this controversy (concerning the Idwal moraines) centres on the long ridge on the west side of the cwm (Fig. 1). The interpretations of it include:

- (i) *Lateral moraine*. This was Darwin's (1842) interpretation, and he saw the mounds between it and Llyn Idwal as marking the lateral glacial margin as it shrank.
- (ii) *Protalus rampart*. Unwin (1970; 1977) and Escribá (1971) favoured this interpretation, though unlike most other protalus ramparts in Snowdonia, it does not have an arcuate crestline and does not correspond with a concavity in the cliffline above.
- (iii) *Fluted moraine*. This was a suggestion made by Gray (1982), who noted that such moraines are common features of many Scottish corries and valleys glaciated during the Loch Lomond Stadial.
- (iv) *Terminal moraine*. Addison (1983; 1986) believed that ice from Cwm Cneifion accelerated as an icefall into and across Cwm Idwal, and bulldozed the ridge onto the opposite slope. In support of this interpretation he pointed out the steep lateral moraines on the east side of Idwal which rise towards Cwm Cneifion, and the presence in the ridge of "erratic breccias and distinctive tuffs from Cwm Cneifion" (Addison, 1986, p.11). Against this interpretation, however, is the fact that the alignment of the ridge is oblique to the line of movement from Cwm Cneifion.

The present author favours interpretation (i) or possibly (iii) with formation related to a Loch Lomond Stadial glacier moving along Cwm Idwal."

Unfortunately, in the Guide interpretation (iii) is missing and interpretation (iv) has been moved up to (iii). Hence, the last sentence of the above quote associates me with Addison's terminal moraine interpretation rather than with the possibility of fluting.

Discussion during the field visit clarified a number of points. Jim Rose spoke in favour of the fluted moraine interpretation, because of the pattern of parallel ridges present to the west of Llyn Idwal (Fig. 1). Others, however, felt that the main ridge is too steep-sided to be a flute. Also the mounds below the main ridge are not exactly parallel to it, but instead diverge in a manner that would support ice-marginal accumulation related to a shrinking glacier.

Ken Addison spoke in favour of interpretation (iv), though the erratic evidence for ice movement from Cwm Cneifion is now less certain. He pointed to the marked differences in the size and form of the moraines on either side of the llyn. He felt that this could be explained by the higher-level Cneifion ice becoming more dominant as the equilibrium line rose at the end of the stadial, resulting in the glacier moving obliquely across Cwm Idwal to form the west bank moraines at its snout. Dougie Benn, however, felt that the within-cwm asymmetry of the moraines might be due to differences in debris supply, in turn related to differences in rock mass failure on the two sides of upper Cwm Idwal. This explanation of within-valley asymmetry of lateral moraines has recently been proposed for a number of Loch Lomond Stadial glaciers in north-west Scotland (Benn, 1989).

Although no vote was taken at the end of the field discussion, we may well be back with Darwin's (1842) lateral moraine interpretation!

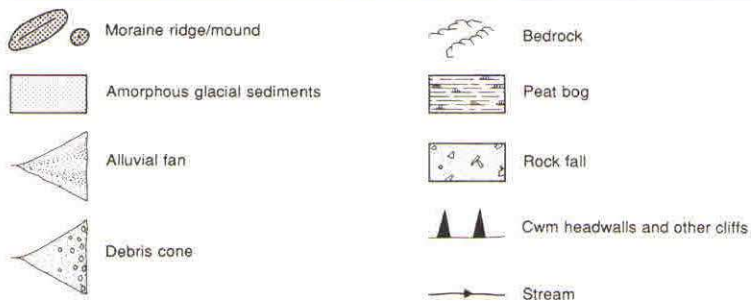
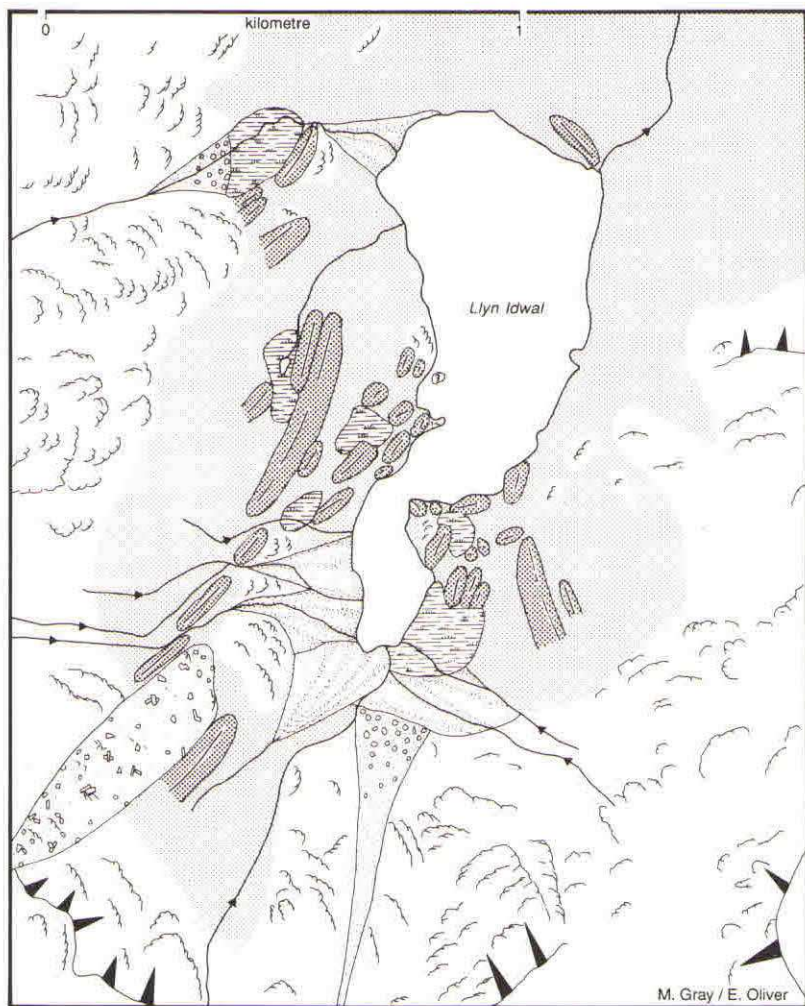


Fig. 1 Geomorphological map of the floor of Cwm Idwal.



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## FLINT PEBBLES OF NORTHERN PROVENANCE IN EAST ANGLIAN QUATERNARY GRAVELS

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## INTRODUCTION

The presence of far-travelled clasts in East Anglian gravels of all ages has long been recognised (e.g. Prestwich, 1871; Solomon, 1935; Hey, 1976). The lithologies which are represented include quartz, quartzite, igneous rocks and cherts from Carboniferous, Jurassic and Cretaceous beds (Hey, 1976). The origin of these has been variously ascribed to sources in the Ardennes (quartz and quartzite; Prestwich, 1871), North Wales (volcanics; Hey and Brenchley, 1977), Yorkshire (*Rhaxella* chert; Hey, 1976) and the English Midlands (quartz, quartzite and Carboniferous cherts; Hey, 1976, 1980). Bridgland (1986) indicated that all of the pebble lithologies which are present in East Anglian Lower Pleistocene gravels can be ascribed to sources within Britain. The proposed transport paths for these lithologies are diverse, including glacial, fluvio-glacial, fluvial and marine mechanisms. In particular, Hey (1976) suggested the possibility of *Rhaxella* chert from the north being introduced to East Anglia by longshore drift or by icebergs.

This paper concentrates on Crag gravels and the Westleton Beds and reports the existence of a previously unrecognised suite of erratic flints within these gravels. These distinctive flint pebbles are thought to derive from outcrops or former outcrops to the north of East Anglia, on the basis of their properties in hand specimen and their micropalaeontological content. This latter line of evidence is a valuable new tool for Quaternary research. The most likely method of transport of these pebbles is by longshore drift during the Lower Pleistocene.

## ERRATIC FLINT IN EAST ANGLIA

Gravel samples from throughout the distribution of the Westleton Beds (Hey, 1982) and from older Crag pebble beds have been examined for their constituent lithologies. In the course of this examination, it was noticed that a small, but significant proportion (6–10%) of the flint pebbles encountered were dissimilar to either the black flint of the Chalk in the Norwich area or the flints from the Chalk or



the Tertiary pebble beds of the London Basin (cf. Bridgland, 1986). This minority, termed "spicular flint" appears to be comprised of two main subgroups (although intermediate types can also be identified). Both types can be identified in hand specimen by a characteristic marbled brown-black surface colouration, although a degree of experience is required to avoid unnecessary pebble-splitting. Spicular flint can also be found reworked into the Kesgrave Sands and Gravels and outwash gravels, though in lower quantities than are present in the Westleton Beds.

The clasts encountered form a continuum between two distinctive end members. At one extreme is a typically grey rock, usually having a brown weathering rind. The grey and brown areas are both usually translucent unless very heavily weathered and exhibit large numbers of white cloudy patches or "hairy blobs" of 0.1–0.5 mm across (Fig. 1). In addition, this type usually also exhibits small voids on fresh surfaces. These voids are marked by yellow/brown edges on grey areas, but are frequently rusty brown or black on weathered areas. Large quantities of spicular debris can often be observed in areas between the voids and white blobs.

At the opposite extreme is a cream/yellow/brown, semi-translucent type, again with rusty brown or black voids. This type often has larger, cylindrical spicule moulds (see Fig. 2).

Both end members and all intermediate varieties have conchoidal fracture, appear predominantly fine grained at magnifications in excess of  $\times 40$  under crossed nicols and have a low birefringence (although the spicules are represented by coarser, chalcedonic areas).

Fresh flint from the Chalk in the Norwich area is characterised by its black colour and by the minimal presence of skeletal debris. The presence of pebbles derived from the Tertiary of the London Basin (or elsewhere; Hey and Auton, 1988) in the Westleton Beds is very difficult to establish since both deposits are characterised by a high flint content, with rounded, chattermarked pebbles dominant (Hey, 1967; Gibbard, 1983). However, such Tertiary-derived pebbles as have been examined have shown none of the attributes of spicular flint.

These findings are significant: the majority of erratic clasts in Lower Pleistocene East Anglian gravels are currently thought to have derived mainly from the London Basin or from the English Midlands (Hey, 1976, 1980), the major exception being *Rhaxella* chert from the Yorkshire Corallian. This presence of material of northern provenance in the Westleton Beds led to the suspicion that the spicular flints, which were evidently not derived either locally or from the south, might also have come from this direction. The grey subgroup were very similar to the flints of Lincolnshire, as described by Wood and Smith (1978).

However, much stronger evidence has resulted from discussion with Ian Brooks, formerly of the University of Sheffield. Brooks (1989) outlined the use of constituent microfossil assemblages (mainly foraminifera) in the sourcing of flint artefacts in Lincolnshire and Yorkshire. This technique can source flint not only to a particular area, but even to an individual flint band. The question of secondary derivation obviously remains a problem. On the basis of an examination of a number of thin flakes of the two main types of spicular flint, Brooks (personal communication) has suggested a good correlation between the greyer end member and flints from the Welton and Burnham Formations of Lincolnshire. The second type is very similar to clasts from the tills of Holderness, for which no primary source has yet been located.

## A NEW TOOL FOR CLAST LITHOLOGICAL ANALYSIS

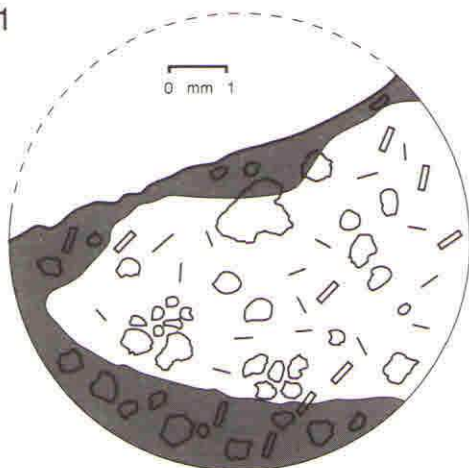
Sourcing of flint by means of its micropalaeontological content has been described by Brooks (1989) as "labour intensive". Nevertheless its implications for Quaternary research would appear to be considerable since it could be applied not only to flint but also to siliceous rocks from limestones of a variety of ages. For example, the palaeogeography of the proto-Thames system has been reconstructed on the basis of quartz, quartzites and volcanic clasts within its gravels (e.g. Rose et al, 1976; Hey and Brenchly, 1977). The Carboniferous cherts have been largely ignored. An analysis of the micropalaeontology of these cherts might allow for a more detailed reconstruction of the former Thames drainage basin. Furthermore, many gravel bodies in Southern England contain cherts which cannot be unequivocally ascribed to a particular geological period on the basis of macroscopic characteristics alone. Systematic application of the technique here described might help to resolve this and other problems, e.g. the origin of the Buchan Ridge of North East Scotland.

# Features typical of spicular flint in East Anglian Gravels

1 Lincolnshire type as viewed at x20 magnification

2 "Holderness" type as viewed at x20 magnification

Fig. 1







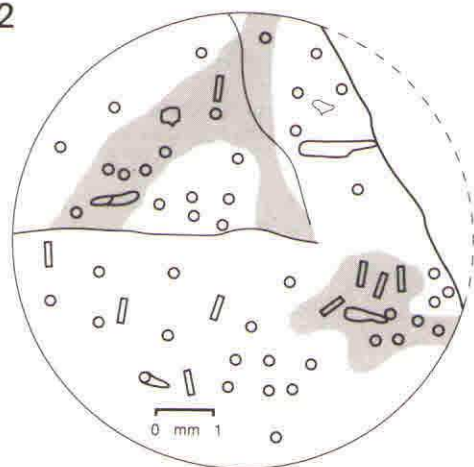


-  "hairy blob"
-  spicule
-  void
-  brown staining

Fig.2



-  spicule moulds
-  yellow/brown staining

## CONCLUSIONS

On the basis of both macro- and microscopic characteristics, spicular flints in East Anglian Lower and Middle Pleistocene gravels can be sourced to the Lincolnshire/Yorkshire area. This evidence, combined with the significant *Rhaxella* chert signal within the Westleton Beds suggests widespread transport of material derived from the north to the Westleton shoreline. It is proposed that the most likely mechanism for this transport would have been longshore drifting, although some material may have been incorporated from the floor of the North Sea as a result of wave activity early in the development of the Westleton Beds (a more recent analogue for this situation is the development of Dungeness on the south coast of England: Eddison, 1983).

The use of micropalaeontology as a means of locating the provenance of flints and cherts is a technique which could be of considerable value to Quaternary research, by extending the scope of clast lithological analysis beyond what is presently feasible.

## ACKNOWLEDGEMENTS

The author wishes to thank Ian Brooks for his time in studying the specimen clasts and in explaining the basis of the technique. Previous discussion of sources had involved Peter Allen of City of London Polytechnic, Andy Gale and Dave Wray of Thames Polytechnic, and particularly Dave Bridgland of City of London Polytechnic; the contribution of all was much appreciated. The work was carried out while a research assistant in the Sir John Cass Quaternary Research Unit, City of London Polytechnic. The diagrams were drawn at City of London Polytechnic by Gareth Owen of the City Cartographic and Desk Top Publishing Unit. Finally, thanks are due to Geraint Coles of Edinburgh University for putting the author in touch with Ian Brooks.

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## WATER-SURFACES AS INSECT TRAPS AND SOME CONSEQUENCES FOR PALAEOENTOMOLOGY

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### Introduction

Your own garden can be an excellent place for scientific observations (e.g. Owen, 1981, 1983; Owen and Owen, 1975). This particular study was carried out in such a rather limited environment. It all began when one day I noticed a number of insects floating around on the water surface of my small daughter's bath pool, placed on the lawn in our garden. It had been filled with water and left unused for about one week. I was struck by the abundance of dead or still-living insects that in such a short time had been caught by this small surface of water.

In Quaternary palaeoentomology, as in other types of Quaternary biostratigraphic studies, interpretations on the fossil records should be based on information from observations on the present flora and fauna. One problem when working with subfossil insects, is how to interpret individual insect frequencies from lake-sediment samples. Another difficult question is whether the fossil insect assemblages only originate from a very local fauna that lived in the immediate surroundings of the sampled site, or if they also reflect more distant faunal elements.

Insect remains in lake sediments originate from different sources, mainly (1) transport by brooklets or rivers from their catchment area into the lake, (2) surface-water runoff into the lake, (3) snowdrift onto the lake ice, (4) airborne insects caught on the lake surface and, of course, (5) species that lived in the lake. Unfortunately there are very few published studies on present observations of the transport of insects to waterbodies and their accumulation in lake-sediments. This paper presents a small study on the airborne component of insects, trapped on a watersurface and then deposited on the lake bottom. The little pool used in this study was ideal for investigating the component of airborne insects, as the only way for the insects to get into the pool was from the air or by climbing. These observations might contribute some information to the discussion of the origin of insect fossil assemblages.

### Methods

The bath pool, made of plastic foil stretched on a framework of plastic tubes, measured 1.2 x 1.2 m and was 0.25 m high. During the period of observation, it was filled with c. 10 cm of water. The experiment was carried out over about one week, at the end of which all insects were recorded. The pool was not used for any other purpose during the period and was placed in an open area on the lawn, free from overhanging vegetation. Our garden is rather small, c. 800 m<sup>2</sup> and is surrounded by a number of similar

gardens separated by hedges. The lawn occupies about half the area of our garden, the other half being occupied by bushes, trees and other cultivated plants. The small village where I live is situated in an area characterised by extensive agriculture, mainly fields with different cultivated crops. Some remnants of semi-natural vegetation are found within a radius of a few kilometres.

During the week of observation, the weather changed several times, including rain and sunny periods. The temperatures during daytime were, in general, lower than normal for the month of July in southern Sweden, 15–17°C. Under such conditions, one would expect that the insect activity, especially the flying activity, was not exceptionally high, rather the contrary. The weather was not very windy either.

The insect taxa found in the pool are presented in Table 1. No effort was made to identify all the specimens down to species level except those belonging to the order of Coleoptera, which I am most familiar with. Identification keys as V. Hansen (1965), Hansen (1987), Hansen & Henriksen (1927), Lindroth (1986) and Palm (1963) were used to help determinations.



## Results

The bath pool in this study may represent a natural pond or small lake without any outlet or inlet. Since it was standing on the ground surface, no inwash from the surroundings were possible either. The only way the insects could have come into the pool were by wind, active flying or climbing.

346 individuals divided amongst 17 taxa were recorded (Table 1), and all had entered the pool during the week when the study was being carried out. All insects were adults (imago). The majority of the animals belong to the Coleoptera (beetles). In subfossil insect assemblages from lake sediments, beetles are usually one of the most abundant components, only outnumbered by larva remains of midges (Chironomidae, Diptera). 97.4% of the recorded arthropods were winged and had the ability to fly. Only the workers of ants (Formicidae, Hymenoptera) and the spiders are certain to have climbed into the pool. By observing the pool constantly for a longer period, it seems clear that the vast majority of the flying insects must have entered the pool by flying and were then trapped on the water-surface. Only the waterbeetles *Helophorus brevipalpis* and *Hydroporus* cf. *rugifrons* could be considered to live in a biotope similar to the pool. They were observed, however, feeding on the corpses and living individuals of the other arthropods during the week. All except the aquatic insects may have suitable biotopes in close vicinity, for example, in the garden where the pool was standing. The aquatic taxa probably originate either from pools or other types of water containers in the neighbourhood or from a small river about one kilometre away. It is thus evident that the recorded fauna in this case is mainly of a local character. 45.1% of the trapped insects had, during the week under investigation, already sunk to the bottom. However, the larger species of Coleoptera and Hymenoptera were, in general, still floating on the water-surface.

Very few animals had disintegrated during this short period. The only observed cases were those that had been damaged by the water-beetles feeding on them.

## Conclusion

This is a very brief study on the accumulation of insects into lake sediments. However, it has produced some very interesting results, which may be summarised as follows:

- (1) It seems very likely that a large proportion of the insects incorporated into lake-sediments originates from airborne animals that have been trapped on the water-surface and within a week had sunk to the bottom.
- (2) The deposition of insect corpses, initially floating on the water-surface, occurs rather rapidly after trapping. It seems that smaller insect species sink after a shorter time than larger specimens.
- (3) The insect assemblages from lake sediment are probably, in general, of a rather local character. However, this does not imply that all subfossil insects in lake sediments and especially those with large water-surfaces might derive a proportion of their assemblage from animals living several kilometres away (see Kenward, 1976).

**Table 1** Recorded insect taxa from the bath pool. Total number of living (within brackets) and lifeless individuals. (A) insects found on the water surface, (B) insects on the bottom of the pool.

| TAXA                                         | A       | B   |
|----------------------------------------------|---------|-----|
| <b>HEMIPTERA</b>                             |         |     |
| Cercopidae                                   |         |     |
| <i>Neophilaenus</i> sp.                      | 1       |     |
| Lygaeidae                                    |         |     |
| <i>Lygus</i> sp.                             | 1       |     |
| <i>Calocoris</i> sp.                         | 1       |     |
| <b>DIPTERA</b>                               |         |     |
| Fam. indet.                                  | (2)     | 1   |
| <b>HYMENOPTERA</b>                           |         |     |
| Formicidae                                   |         |     |
| <i>Formica</i> sp. (worker)                  | (4)     | 3   |
| <i>Formica</i> sp. (male)                    | 2       | 2   |
| Apidae                                       |         |     |
| <i>Apis mellifera</i> L.                     | (1)     | 4   |
| <i>Bombus terrestris</i> L.                  | (1)     |     |
| Fam. indet.                                  | (2)     | 2   |
| <b>COLEOPTERA</b>                            |         |     |
| Carabidae                                    |         |     |
| <i>Amara familiaris</i> Duft                 | 1       |     |
| Dytiscidae                                   |         |     |
| <i>Hydroporus</i> cf. <i>rufifrons</i> Müll. | 1       |     |
| Hydrophilidae                                |         |     |
| <i>Helophorus brevipalpis</i> Bedel          | 56      |     |
| Staphylinidae                                |         |     |
| <i>Platydacus stercorarius</i> Oliv.         |         | 1   |
| <i>Leptacinus</i> cf. <i>pusillus</i> Steph. | 1       |     |
| Nitidulidae                                  |         |     |
| <i>Meligethes</i> spp.                       | 62 (46) | 142 |
| Coccinellidae                                |         |     |
| <i>Coccinella septempunctata</i> L.          | 3 (2)   |     |
| Curculionidae                                |         |     |
| <i>Ceutorhynchus</i> sp.                     | 3       |     |

### Acknowledgements

The Author would like to thank Professor John Birks and Dr Russell Coope for valuable discussion and suggestions made on the manuscript of this paper.

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*Editor*

# Reports

## IGCP-253 AND THE NORTH ATLANTIC SEABOARD PROJECT

At a meeting in Paris in January 1990, the Board of the Earth Science Division of UNESCO formally adopted a new IGCP project, entitled *IGCP-253: Termination of the Pleistocene*. The aim of the project is to co-ordinate the work of research groups from around the world to establish an integrated approach to the study of the last glacial-interglacial transition (approximately 18 000–8000 BP). Of especial interest are (a) the inter-relationships and interactions between climate and the global hydrologic cycle and (b) the nature and global expression of abrupt climatic changes during this period. The purpose of this note is to give some background to IGCP-253 and to draw attention particularly to one of the major sub-projects, the *North Atlantic Seaboard Project*, in order to invite the participation of those who wish to collaborate in the work and discussions.

### QUATERNARY IGCP PROJECTS

In total there are 61 formally-approved IGCP projects which are running or are due to commence during 1990. Of these, only 8 are recognised as being focussed essentially on the Quaternary. These are:

**IGCP-219 Comparative lacustrine sedimentology through space and time**

(Co-ordinator: K Kelts, 1984–1990)

**IGCP-252 Past and future evolution of deserts**

(Co-ordinator: N Petit-Maire, 1987–1991)

**IGCP-253 Termination of the Pleistocene**

(Co-ordinator: J Lundqvist, 1989–1994)

**IGCP-274 Coastal evolution in the Quaternary**

(Co-ordinator: O Van de Plassche, 1988–1992)

**IGCP-281 Quaternary climates of South America**

(Co-ordinator: J Argollo, B, 1989–1993)

**IGCP-296 Quaternary in the Asia/Pacific region**

(Co-ordinator: J L Rau, 1989–1993)

**IGCP-297 Geocryology of the Americas**

(Co-ordinator: A E Corte, 1989–1993)

**IGCP-299 Geology, climate, hydrology and karst formation**

(Co-ordinator: Yuan Daoxian, 1990–1994)

There is a further proposal, IGCP-292 'Global palaeohydrology', which is presently being considered by the Board (Proposed Co-ordinator: L Starkel).

The Quaternary projects are considered by UNESCO to be integral constituents of the Sub-programme "Quaternary Geosciences and Human Survival" and to contribute to the International Geosphere-Biosphere Programme (IGBP) of the International Council of Scientific Unions (ICSU) as well as to the recently launched programme of IUGS termed "Earth Processes and Global Change". IGCP projects are jointly sponsored by UNESCO and the IUGS.

UNESCO sees IGCP-253 as a very important development, not only because of the great attention being paid to the nature and effects of abrupt climatic changes in general, but also because of the opportunities that exist for developing fine-resolution models of environmental changes during the last glacial-interglacial transition in particular.



## IGCP-253

This project arose out of collaborative efforts between a number of working groups established in the Nordic countries, Canada, Czechoslovakia, UK and the USSR. Negotiations took place largely between 1987 and 1989 on an informal basis. Research groups from other regions applied to participate, including the Netherlands, FRG, Poland, USA, Argentina, Costa Rica and New Zealand. On the basis of an agreed strategy and programme, a formal application was made to the IGCP Board during 1989 through the elected Co-ordinator, Professor Jan Lundqvist (University of Stockholm). A provisional approval was given subject to certain conditions being met, which included a wider global programme and a clearer set of objectives with a specified schedule.

A meeting of representatives was called in Lund, Sweden in November 1989, to draw up a revised application. The resulting re-submission was approved by the Board in January 1990. A business meeting of the newly-born IGCP-253 was called in May 1990, to finalise some of the details of the project, the essential elements of which are as follows:

### Summary of Organisation of IGCP-253:

Project Leader: J Lundqvist (Stockholm University)  
Project Secretary: M Saarnisto (Geol. Forskningscentralen, Finland)  
Project Group: D Q Bowen (University of Wales, Aberystwyth, UK)  
J Rabassa (CADIC-CONICET, Tierra del Fuego)  
A Raukas (Inst. Geology, Estonia)

### Working Groups:

- (1) *Regional climatic curves and improved resolution of palaeo-climatic changes*  
(Leader: N Rutter, University of Alberta, President of INQUA)
- (2) *Glacial modelling*  
(Leader: O Orheim, Norsk Polarinstitut, Oslo)
- (3) *Fluctuations of local glaciers*  
(Leader: J Rabassa, CADIC-CONICET, Tierra del Fuego)
- (4) *North Atlantic Seaboard lacustrine and vegetational changes*  
Leader: J Lowe, University of London, UK)
- (5) *Depositional changes in non-glaciated regions*  
(Leader: J Tyracek, Geol. Survey, Prague)
- (6) *Environmental history and drainage of large ice-dammed lakes*  
(Leader: J Teller, Dept of Geological Sciences, Winnipeg, Manitoba)
- (7) *Global Younger Dryas*  
(Leader: D Petet, Goddard Institute for Space Studies (NASA), New York)
- (8) *Changes in permafrost conditions*  
Leader: R Vaikmae, Estonian Academy of Sciences)
- (9) *Environmental changes*  
(Leader: L Serebryanny, Institut Geografii, Moscow)

A number of Regional Co-ordinating Groups have also been established to co-ordinate the work on a regional basis and to guard against excessive overlap between the sub-projects.

For further information on the scope and objectives of IGCP-253, enquiries should in the first instance be directed to the Working Group Leaders.

## NORTH ATLANTIC SEABOARD PROJECT

This is a short informal title for the Working Group formally called 'North Atlantic Seaboard lacustrine and vegetational changes' within IGCP-253. NASP is a collaborative research programme aimed principally at providing a high resolution and high quality stratigraphic and geochronological data-base for the evaluation of abrupt climatic changes during the last glacial/lateglacial episode (14 000-9 000 BP). The work will be based specifically on terrestrial records in order to provide an independent assessment of the climatic models proposed on the basis of oceanic evidence. Since a higher resolution can be obtained from terrestrial records, in both time and space, the results of this programme should provide a sensitive record of climatic shifts in and around the North Atlantic.

This group-project arose out of a European co-operative programme which is now at the advanced planning stage. More than 20 research groups from around Europe (Appendix I) have agreed to collaborate in building a European data-base (the *European Atlantic Seaboard Project*), which will provide reviews of existing data as well as new research results obtained within an agreed strategy and methodology. The basis is set for a comprehensive review of stratigraphic information from Iceland to the Canary Islands and Morocco, which will enable us to test existing theories on movements of the Polar Front, amplitude of climatic shifts in different parts of Europe, climatic gradients and synoptic climatic patterns.

More recently, research groups from North America requested expansion of the programme to examine climatic developments in seaboard areas on both sides of the Atlantic. One of the most exciting recent developments is the discovery of climatic shifts in North America contemporaneous with the so-called Younger Dryas event, which was hitherto regarded as a European phenomenon. Such is the impact of this new information, that it has triggered something like a dozen publications in major science journals over the past 12 months on the cause and geographical expression of the Younger Dryas; the new evidence has major implications for our overall understanding of Lateglacial circulation patterns.

A wider programme has therefore evolved, termed the *North Atlantic Seaboard Project*. Dr J Lowe (RHBNC, University of London) will co-ordinate the programme as a whole, and has been elected leader of a European Study Group. Dr L Cwynar of the University of New Brunswick, Canada, will lead a North American Study Group (Appendix II). The overall aim is to establish the nature and synchronicity of climatic changes in areas fringing the North Atlantic during the period 14 000-9 000 BP.

The governing committee of IGCP-253 has decided that the Working Group will operate in the first instance for 4 years (1990-94). The following provisional timetable and general structure is therefore being proposed for the operation of the *North Atlantic Seaboard Project*:

- |            |                                                                                                                                                                                                                                                        |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| March 1991 | <ul style="list-style-type: none"><li>● Inaugural closed workshop in London</li><li>● Definition of aims and objectives of project</li><li>● Research strategy, methodology, priorities</li><li>● Specific objectives for a deadline of 1993</li></ul> |
| 1993       | <ul style="list-style-type: none"><li>● Mid-project Progress Workshop, venue North America</li><li>● Results and problems</li><li>● Redefinition and modification where necessary</li><li>● Specific objectives, priorities for end-1994</li></ul>     |
| 1994/1995  | <ul style="list-style-type: none"><li>● Reports Workshop (venue to be decided)</li><li>● Report and publication of results</li><li>● Overall conclusions: assessment of future research imperatives</li></ul>                                          |

In addition, an open meeting is being considered to coincide with the annual meeting of the Geological Association of Canada/Mineralogical Association of Canada in Wolfville, Nova Scotia in May 1992.

Close co-operation will also be maintained with other relevant international research initiatives, since participants in this project are also deeply involved in other programmes. There are, for example, direct links with the *European Palynology Database*, the *INQUA EuroSiberian Subcommission for the Study of the Holocene*, the *Global Younger Dryas* Sub-project of IGCP-253, and relevant research projects currently being funded by the NERC and by the BEC within the second phase of the *EPOCH* programme.

For Further details of the **North Atlantic Seaboard Project**, write to:

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## APPENDIX I

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## APPENDIX II

### *COLLABORATORS AND REGIONAL CONTACT PERSONNEL NORTH AMERICA STUDY GROUP (PROVISIONAL LIST)*

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10025, USA

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### **PARTICIPATION OF UK SCIENTISTS IN IGCP-253**

The Earth Resources Committee of the Royal Society, UK, seeks to encourage the participation of UK scientists in IGCP-253, and funds will be available to assist attendance at planning and co-ordination meetings. Dr J J Lowe of the University of London has been appointed as UK National Correspondent to IGCP-253 by the Royal Society, and initial enquiries should be directed to him at:-

Department of Geography  
Royal Holloway and Bedford New College  
University of London  
Egham Hill, Egham  
Surrey TW20 0EX

Tel: 0784-443565  
Fax: 0784-472836

## **SHALLOW GAS GROUP MEETING, HERIOT-WATT UNIVERSITY, EDINBURGH, SEPTEMBER 19-21 1990**

This meeting was attended by some 50 to 60 people representing a diversity of biological, geological and engineering interests in circum-North Sea states and North America. Shallow gas is an important component of Quaternary sediments, especially marine sediments, but has until recently been unappreciated except by engineers. The gas may be biogenic (formed by bacteria) or thermogenic (not formed by bacteria) or a mixture of these components. Thermogenic gas in, for example, the North Sea and Irish Sea basins leaks up to the surface sediments along suitable conduits (e.g. faults) and may be evolved into the water column and hence ultimately to the atmosphere. Biogenic gas is also important, especially where thick sequences of sediment which trap organic matter have been developed. This may be the type of gas commonly producing anomalous reflections in seismic profiles across the deltaic Pleistocene sediments of the still subsiding North Sea Basin.

Shallow gas has been reported from shelf seas around the world. Where present, it provides a focus for bacterial activity (which may have a significant effect on local ecosystems); may produce hardgrounds through cementation by carbonate precipitates; deform stiff clay strata or create morphological features such as pockmarks; and provide a major source of methane contribution to "greenhouse" gas. Surprising numbers of occurrences of nearshore post-glacial gas generation were demonstrated at the meeting. Slightly older gas, generated in nearshore marine interglacial deposits, has been utilised in Jutland as a source of energy.

All the above phenomena must also have occurred throughout the geologically recent past; during environmental reconstructions based on geological data, some thought therefore needs to be given to the possibilities of the influence of shallow gas.

D Jeffery  
British Geological Survey  
Keyworth

## **SHORT REPORT ON INQUA "CROMER SYMPOSIUM" HELD AT UNIVERSITY OF EAST ANGLIA, NORWICH, 2-7 SEPTEMBER 1990**

Sixty five delegates from 15 countries (including far-flung ones such as the USSR, USA and Australia) attended this symposium, which was called to discuss various aspects of, and correlations within, the Lower Middle Pleistocene of Europe.

Two days of lecture and poster topics, varying from the Cromian beetle faunas of the East European plain and eastern England to the genesis of gravel deposits and palaeosols in the latter area and in Switzerland, culminated on the 4th in evening meetings of specialists attempting to resolve differences over the placing of the lower boundary of the Middle Pleistocene. Geologists repaired to the bar! Finally, news came that an agreement had been reached — to defer a decision until a later occasion.

The three days of field excursions proved to be a valuable part of the symposium, especially as the weather chose to be kind to the participants.

On the first day, the classic sections including the type Cromerian were visited at Sidestrand and West Runton. Lively discussion ensued over matters as diverse as the sedimentological meaning of some pollen assemblages, the genesis of Anglian glacial deposits and the amount of pedogenesis within the deposits. One delegate, gazing out to sea, asked if the deposits occurred there, to which he was, to his surprise, given a lengthy, but perhaps unenlightening, discursive response on tectonics and erosion.

The second excursion was to sites in the vicinity of Ipswich (Great Blakenham, Little Oakley and Ardleigh) to examine the fluvial Kesgrave Formation. At the last stop, Ardleigh, the formation is particularly well exposed in a rather deep and somewhat unstable pit which was not being worked on that particular day owing to a breakdown on the excavator. (Many a muttered curse was mingled with the clink of spanners in the machinery housing.)



On the final day, after an overnight stop at Royal Holloway and Bedford New College near Egham, the highlight of the week was the visit to the archaeological site at Eartham, Boxgrove, in Sussex. Here, beach and very shallow-marine deposits now lying at 40 m above sea level contain abundant evidence of human occupation; excavation of the remains of a butchered horse attracted various comments. Meticulous work is revealing much about the palaeoecology of the site but unambiguous dating of the deposits remains somewhat elusive. A pre-Anglian date of about 400 000 years BP is probably indicated but it would not be surprising if the site turned out to be even older. There was extended discussion and speculation about why Lower Palaeolithic (wo)man was there, how (s)he got there and the possible anthropogenic modification of the environment. A tour of the somewhat antediluvian accommodation and workshops on the site was given to delegates, following a splendid picnic lunch organised by the site director.

Delegates then made their various ways back home at the end of what was a fascinating week. Thanks must go to Charles Turner and his various assistants for the organisation and way in which they coped with the last-minute changes sought by their guests.

D Jeffery  
British Geological Survey  
Keyworth

#### **SHORT FIELD MEETING REPORT: BEAULY TO NAIRN, 14-18 SEPTEMBER 1990**

Tarradale House—the birthplace of Sir Roderick Impey Murchison, sited on a raised platform overlooking the Beaully Firth — was the historic setting for this latest QRA 'short' field meeting. Punters, who had to travel from remote places such as from south of the Thames, necessarily undertake cost benefit considerations prior to making a commitment to attend a field meeting in northern Scotland. Not least amongst these concerns the likely weather. Luckily, the first morning dawned fine with a ground frost, a reminder of the 700 km more northerly latitudinal position than the previous day. The following four days were fine throughout save for the last hour or so on the final day when, as dusk approached, a depression made its arrival evident. However, by that time the programme was in the optional mode and only five soles remained to brave the driving rain.

It was precisely a decade ago when the QRA last mounted a field meeting in the Inverness area and on that occasion the main platform was occupied by John Smith and Francis Synge who demonstrated their interpretation of the deglacial history of the area. Alas Francis was to be with us for only three more years but John in both his capacity as warden of Tarradale and association member was able to participate on this occasion. Indeed, his masterly command of the logistics and understanding of the elixir necessary for a successful QRA field meeting did much to make the 1990 event so rewarding. A further bonus was the opportunity to experience the humorous John S junior as aide de camp to John S senior. Each evening the party retired after dinner to the magnificent library of Tarradale where the leaders of the following days itinerary gave introductions to their topics. Although in some respects the turn out for the meeting (some 25 members) was disappointing considering the significance of the programme, the size of the party was ideal for generating group discourse both indoors and out.

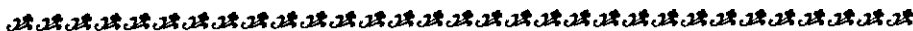
The field activity commenced with the party standing on the northern approach road to the Kessock Bridge which spans the narrows between the Beaully and Inverness (Inner Moray) Firths. This spot provided an excellent viewpoint from which the geographical layout of the Inverness area could be appreciated. Immediately to the south lay the delta of the River Ness in the throat of the northern exit of the Great Glen and on this feature the regional capital is situated. Most of the localities which would be visited pertinent to one of the two major themes of the meeting, i.e. ice limits and sea change level history, could be identified in the landscape from this spot. Our guides for this were Callum Firth and Andrew Haggart. Callum was primarily concerned with the 'late glacial' history and was able to convince most, including John Smith, that the interpretative model presented in 1980, which focused on a major glacial readvancement to the mouth of the Inverness Firth, was at variance with his conception of

a single retreat sequence. Both the sedimentological and shoreline landform evidence examined by the party appeared to be consistent with Callum's hypothesis. In discussion, the potential role of sub-aqueous outwash sedimentation was highlighted. On the last day, Andrew Haggart concentrated on the Flandrian shoreline record and in particular was able to demonstrate the 'anomalous' presence of a sand unit in otherwise fine grained carse sediments. This feature had originally been taken to represent a tidal surge event but more recently opinion has swung in favour of a palaeotsunami triggered by a major slide on the Norwegian continental slope in the early Flandrian.

The other main theme related to the pre Late Devensian glacial history. This centred on the just completed 'official' British Geological Survey mapping of Clive Auton and Jon Merritt of the ground south east of Inverness. Perhaps contrary to initial expectation of a zone close to the major ice sheds, both extensive tracts of thick glaciogenic materials and considerable amounts of highly weathered bedrock characterise the area. The classical shelly clays of Clava lying at some 150 m OD occur within their mapping area and with the help of John Gordon from the Nature Conservancy Council a new section through part of the clays was made available specially for the meeting. Jon, in conjunction with a previous site expert Douglas Peacock, built a convincing picture of the clays having been emplaced by glaciotectonic processes as an allochthon. Not all the assembled evidence turned out to be of a glaciotectonic origin, however, and at one exposure the tensional wedges turned out to be minor surficial rills seen in cross section. Apart from the Clava, the other stratigraphic highlights were the sections at Dulcharn and Allt Odhar where *in situ* interglacial and possible interstadial sequences have been identified—these, it must be emphasised, are located on the flanks of the Grampians. But it was not all sectional evidence which was examined for a superb range of glacial landforms along the middle Findhorn river were also demonstrated.

In retrospect, possibly the most significant aspect of this field meeting was that here, possibly for the first time, the Quaternary mapping research results of the BGS were being made available to the QRA almost before the inked lines on the maps were dry. As a result the community was able to interact with this most recent of BGS work before the ensuing official publications are written. We must applaud both the quality of the mapping and the initiative taken by Clive and John in seeking to enable the QRA members to experience the evidence first hand. We must not forget the enlightened management support which made this possible. Significantly the BGS Programme Manager for the Highlands Don Mallick joined the party and one is led to ponder when, if ever, has this kind of support been forthcoming in the past. It can only encourage greater co-operation between BGS and the wider community within the QRA for we must not overlook the fact that the largest membership group in the QRA is drawn from BGS. The 1990 Inverness meeting was undoubtedly a milestone in the association's development and all are encouraged to read the details in the superb field guide edited by Clive, Callum and Jon—its a gold mine of new data on the area.

Peter Worsley



# Abstracts



## SEDIMENTOLOGICAL, MINERALOGICAL AND GEOCHEMICAL STUDIES OF HOLOCENE COASTAL SEDIMENTS, SOUTH-WESTERN SCOTLAND

Liftaa S Kadem

PhD Thesis, Department of Geology & Applied Geology, University of Glasgow, 1990

Holocene raised coastal sediments of the Dalbeattie, Kirkcudbright and New Abbey areas in Galloway, and the area of the former Lochar Gulf in Dumfriesshire, together with present-day intertidal surface sediments from the first three of these areas, were studied. In Part I, the nature of the research project and previous related work is considered. A summary of the geological setting of the field areas is also given.

The first half of Part II is concerned with the methods used in data-recording and sample collection in the field and with stratigraphical correlation of the Holocene raised coastal sediments within the Dalbeattie, Kirkcudbright and New Abbey areas on the basis of exposed vertical sections and auger-drilled boreholes. Correlation of the sedimentary sequences recorded in these sections and boreholes suggests that several sedimentary facies can be distinguished in the three areas studied in this way. Four sedimentary facies are also recognised within the present-day intertidal deposits of the same areas. Following a discussion of the concept of sedimentary facies, previous recognition of such facies in SW Scotland and the criteria on which sedimentary facies were distinguished in the course of the research project, descriptions of the present-day and Holocene facies are given. The four sedimentary facies recognised within the present-day intertidal deposits are: tidal-flat, tidal-creek, salt marsh and sand-barrier. The seven sedimentary facies recognised within the Holocene sediments are: A, complex of fine-grained sediments; B, inter-laminated fine sand and silt; C, coarse sand with pebbles; D, fine sand, rich in microfaunal remains; E, clays, rich in plant debris; F, coastal gravel and sand and G, peat.

In Part III, data on the shapes, sphericity, roundness and lithological compositions of Pleistocene glaciofluvial and Holocene storm-beach gravel deposits in the Dalbeattie area are presented and compared. Pleistocene clasts are mainly discs, Holocene clasts mainly blades; sphericity ranges between 0.5 and 0.9 in both cases, but the degree of roundness is greater in the Holocene clasts than in the Pleistocene. Greywacke is the commonest rock type in both. The Pleistocene gravels probably were derived mainly from the north-west and west, the Holocene gravels partly from the Criffell-Dalbeattie granodioritic pluton and partly from Pleistocene glaciofluvial deposits. The results of orientation studies of (mainly) Holocene gravel clasts in the Dalbeattie and New Abbey areas are also given. They suggest deposition by SE-NW water flow. Detailed grain-size analysis indicates that most of the Holocene sediments in the Dalbeattie area and in the upper part of the successions in the Kirkcudbright and New Abbey areas (sediments of facies A) are of silt grade and bimodal or polymodal in grain-size distribution, whereas sand-grade and unimodal grain-size distribution predominate in the Holocene sediments (of facies D) in the area of the former Lochar Gulf and in the lower part of the succession in the Kirkcudbright and New Abbey areas. The present-day intertidal sediments of the Dalbeattie, Kirkcudbright and New Abbey areas are mainly of fine-sand grade and unimodal in grain-size distribution. In descending order of abundance, illite (mainly with the composition of biotite and muscovite), chlorite (mainly Fe-chlorite), kaolinite and vermiculite are the main clay minerals present in both the present-day intertidal and Holocene raised coastal sediments in the areas studied. Both detrital and authigenic illite, chlorite and kaolinite are present; in the case of chlorite and kaolinite, detrital material

greatly predominates over authigenic material. Vermiculite is more abundant in the uppermost facies, A, than in the various underlying facies. Mixed-layer clays and montmorillonite are present in minor amounts in the Holocene sediments. Geochemical analysis of bulk samples and samples of the clay fraction of both the Holocene and present-day sediments indicates that the  $\text{SiO}_2$  content, which is inversely related to the content of  $\text{Al}_2\text{O}_3$ , total iron,  $\text{TiO}_2$ ,  $\text{MgO}$  and  $\text{K}_2\text{O}$ , is higher in the Holocene sediments of the Lochar Gulf area than in the sediments of the same age in the three other areas studied. The  $\text{CaO}$  content in Holocene sedimentary facies D, which is approximately equal to that in the present-day sediments and higher than in the other Holocene sediments, may have been derived from fossil shell and other organic carbonate fragments in facies D. The trace elements Y, Sr, Rb, Th, Pb, Zn, Ni, Co, Ce, Cr, Ba and La are associated with the clay minerals present in the sediments.

Environments of deposition and possible provenances of the Holocene sediments are discussed in Part IV. The environments of deposition recognised, and their corresponding sedimentary facies or sub-facies, were: intermediate to low tidal-flat, facies D; intermediate to high tidal-flat, facies B; high tidal-flat, sub-facies Ab; very high tidal-flat or supra-tidal (salt marsh), sub-facies Ac; salt-marsh, sub-facies Aa; lake or marsh, facies E; storm-beach, facies F. A minor, additional, environment recognised in the New Abbey area only, was that of the fluvial channel-filling (facies C). Determination of provenance of the Holocene sediments on the basis of clay mineralogical and geochemical content must be regarded as very tentative.

## A METHODOLOGY FOR THE INVESTIGATION OF LANDFORM-SEDIMENT RELATIONSHIPS IN BRITISH GLACIATED VALLEYS

J F Raper  
Queen Mary College, University of London

Recent progress in the understanding of the processes and products of glacial deposition in valleys, based mainly on work in actively glaciated environments, has led to the development of a general model of glaciated valley landform-sediment relationships by Eyles (1983). Models which predict sediments from landforms can be of considerable use to engineers planning construction development in relict glaciated valley, where the planning and execution of a ground investigation survey must yield the maximum geological information. This study forms a critical review of the theory and practice involved in the characterisation of, and the inter-relationships between, such landforms and sediments, and proposes a new conceptual model for their analysis, based on the case study of 7 sites in 4 British valleys glaciated during the Dimlington stadial.

Landforms have been characterised by mapping the surface morphology of a series of study areas using air photographs and field survey. A feature-based morphological subdivision of the terrain was used to delineate landform associations used for further analysis. The sediment data from the available borehole sediment log descriptions were initially stored in the geotechnical database GEOSHARE and characterised in order to determine the main sediment facies present in the study area. The identification of sediment facies groups making up the local stratigraphy was carried out by multivariate hypothesis testing. The plotting of the facies identified in the form of cross-sections and the contouring of the unit surfaces has yielded information on the distribution of sediment facies to compare with the distribution of landforms in the study areas in South Wales, and the Central Highlands of Scotland.

By a process of investigation of the landform-sediment relationships of these glaciated valleys, the first steps have been taken towards the identification of some aspects of glaciated valley sedimentary architecture, and the means by which glacial terrains might be investigated using the information stored in the landforms. In particular, it is noted how the appropriate model for landform-sediment relationships in a modern setting should be based on an analysis of postglacially 'evolved' sedimentary sequences in the appropriate local topographic framework. The active glacial settings used by Eyles (1983) are inappropriate as they reflect process environments which are subsequently heavily modified by deglacial events.

## RECONSTRUCTION OF THE BEHAVIOUR OF THE LAURENTIDE ICE-SHEET USING SATELLITE IMAGER

Christopher David Clark, University of Edinburgh

Examination of Landsat imagery of the bed of the last North American (Laurentide) Ice Sheet has revealed a previously undetected pattern of glacial streamlining. Superimposed, cross-cutting, sub-parallel sets of glacial lineations of the order of 2–50 km in length are found to be widespread. They are assumed to reflect successive phases of sustained ice flow, revealing major changes in the geometry of ice sheet flow.

Using six scales of remotely sensed imagery to map the lineations, and establish their cross-cutting relationships, permits relative ages of continent-wide ice flow phases to be determined.

Comparison of the principal ice flow sets with established stratigraphies suggests that the inferred shifts in ice flow occurred during the last (Wisconsinan) glacial cycle. The configuration of ice flow indicates that ice divides migrated by the order of a thousand kilometres.

The evolution of the Laurentide Ice Sheet through the Wisconsinan is reconstructed. There is evidence that during the Early Wisconsinan, ice sheet formation in Keewatin may have been independent of that in Labrador-Quebec, and that these two ice masses coalesced to form a major Early Wisconsinan ice sheet. The palaeo-ice flow evidence indicates that this ice sheet configuration consisted of a trans-Laurentide divide aligned NW-SE across Hudson Bay. Subsequently, the western sector decayed whilst the eastern dome remained stable (Middle Wisconsinan). An ice dispersal centre in the west reformed and fused with the eastern ice mass to form the Late Wisconsinan Ice Sheet. Decay of this ice sheet is well known from existing analyses.

The probability of strong coupling between ice sheet topography and atmospheric circulation suggests that the major changes in Laurentide Ice Sheet geometry must have been associated with large-scale atmospheric circulation changes. The corollary is that the high mobility of mid-latitude ice sheets may help explain the non-linear response of glacial climates to the insolation changes produced by external forcing.



# Announcements



## PRELIMINARY ANNOUNCEMENT OF MEETING AND CALL FOR PAPERS

There will be a joint meeting of a number of Work Groups of the INQUA Commission on the Formation and Properties of Glacial Deposits, in IRELAND in MAY 1991. The meeting will be hosted by the Irish Geological Survey, based at their headquarters in Dublin, and will be followed by a field excursion to the Southeast coast, the Midland area and the West coast. In total, the meeting is expected to last 10 days. The occasion will also be an 'alternate' Commission meeting (see INQUA Commission Newsletter, October 1989).

During the meeting we hope to include sessions on the following themes, (although other suggestions are welcome!):

Mapping of Glacial Deposits  
Glaciotectonics  
Irish Sea Margin Glaciation(s)  
Glacial Sedimentology

### *Papers*

Papers on any of the above themes will be accepted for the meeting. We are negotiating to have papers published, and would like to publish in time for the meeting. In order to achieve this, we need to set and maintain strict deadlines, namely:

FULL PAPERS ..... 31 DECEMBER 1990\*

### *Further details*

Further details and registration forms will be included in a future issue. If, however, you require more information now, please contact either of us at the addresses below:

Dr W P Warren  
Quaternary Section  
Geol. Survey of Ireland  
Beggars Bush  
Haddington Road  
Dublin 4  
IRELAND

Dr D G Croot  
Dept. of Geographical Sciences  
Polytechnic Southwest  
Drake Circus  
Plymouth PL4 8AA  
Devon  
ENGLAND

\*P.S. As the date for abstracts and proposals for papers has passed (30 September) I suggest you contact Dr Warren or Dr Croot direct with this information and then ensure that the other deadline is met.

*Editor*

## NERC RADIOCARBON LABORATORY

The NERC Radiocarbon Laboratory at the National Engineering Laboratory at East Kilbride, is a national facility to provide Radiocarbon Dates for environmental and Quaternary Research carried out by British and collaborating scientists. This note is intended to set out the function and working of the Laboratory, provide some recommendations for those considering applications, and clarify some misconceptions that appear to have emerged.

As is generally known, access to the NERC Radiocarbon Laboratory is through the Radiocarbon Laboratory Steering Committee (RCL-SC). Less well known is that arrangements have also been made by NERC for environmental scientists to have access to AMS dating facilities at Oxford. Because the Radiocarbon Laboratory is a national facility, there is no charge for either conventional or AMS determinations provided they are related to academically sound environmental or Quaternary Sciences. Application for both radiogenic and AMS determinations are made through RCL-SC.

The East Kilbride Laboratory has a finite capacity which is exceeded by the volume of requests for dates, and there is also a limit on the funds available for the purchase of AMS dates by NERC. Hence it is necessary to control access, and this is done by the only acceptable method, that of scientific merit. Additionally, it is considered that the support of high quality science will maintain or increase the degree of interaction that exists between the East Kilbride Laboratory and its users. Indeed, it is believed that if the laboratory were simply a routine provider of radiocarbon dates, without either scientific merit or financial constraints, the quality of research with which it is involved would most probably decline, and the present very high reputation of the Laboratory would be lost.

In the last two years the East Kilbride Laboratory has been re-equipped with state-of-the-art liquid scintillation counters. This has allowed both an increase in the number of samples handled by the laboratory and greater precision of analysis or the assay of small samples than was previously possible. This development notwithstanding, there is inevitably a back-log of samples to be analysed, the queue growing either longer or shorter depending on the number of samples both approved and submitted during a given period. This is an inevitable consequence of the acceptance of all samples that are judged to be of appropriate scientific merit. Time constraints are also imposed by the analytical process as well as the frequency of RCL-SC meetings, but samples are given priority in order to meet specific deadlines, particularly those related to research studentship programmes.

The scientific merit of a particular application is judged solely on the basis of the evidence presented to the RCL-SC. This is axiomatic. All applications should be on one of the *standard application forms* and applicants are requested to pay particular attention to that section of the form that is in **BOLD**, is described as **ESSENTIAL** and contains parts that are UNDERLINED. Failure to do so will almost certainly lead to a request from the committee for additional information. The scientific case should be presented *succinctly*, but evidence must be provided justifying the total number of dates requested as well as the reasons for the selection of particular samples. Specifically, information should be given as to the stratigraphic position of the sample point, and to the provision of supporting environmental evidence where this is available or can be determined. Where AMS dating is desired, this must be specifically justified, particularly in terms of such factors as available sample size.

Finally, the Radiocarbon Laboratory and its Steering Committee exist to facilitate the pursuit of good quality environmental science. Enquiries or visits to the laboratory (Tel: 03552 20222) related to any aspects of radiocarbon analysis are welcomed. In particular research students who are wishing to use the results of radiocarbon assays for the first time are strongly encouraged to visit East Kilbride.

Donald G Sutherland  
Chairman  
RCL-SC

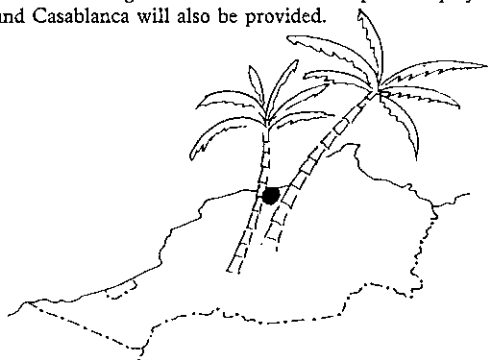
## **ANCIENT SHORELINES AND PREHISTORY: THE PLEISTOCENE GEOLOGY AND ARCHAEOLOGY OF THE CASABLANCA AREA, MOROCCO**

**Casablanca, 13-18 May 1991**

Well preserved Quaternary deposits in the Casablanca region of Morocco provide a remarkable record of successive sea level fluctuations from the Late Pliocene to the Holocene. Evidence of human activity appears in this succession from about one million years ago. The aim of this conference is to present the results of the joint Moroccan-French research programme which has concentrated on the stratigraphy of the Casablanca region and, to review the Moroccan littoral sequence in the context of evidence from other parts of Africa and the Mediterranean. The meeting will include lectures and panel displays. An excursion to visit sites and exposures around Casablanca will also be provided.

For further information contact:

Jill Cook  
British Museum  
Quaternary Section  
38 Orsman Road  
London N1 5QJ  
Tel: 071-323 8810/8811



## **RESEARCH 'LEAVE' AT THE UNIVERSITY OF WATERLOO, CANADA**

The Quaternary Sciences Institute at the University of Waterloo is seeking well-qualified scientists interested in spending post-doctoral or research leave abroad to pursue research on various aspects of Quaternary stratigraphy, geomorphology, climatic history or paleoecology of the Great Lakes Region. Areas of on-going research include mapping glacial lake shorelines, stratigraphy and derivation of glacial deposits, climatic history and paleoecology of interglacial, interstadial, and postglacial deposits using fossil pollen, plant macrofossils, insects, diatoms, molluscs and ostracods.

The University of Waterloo is located in the south-central part of the Great Lakes region in the heart of a classic glaciated landscape produced by competing ice lobes from the Erie, Ontario and Huron basins. The campus lies about 100 km west of Toronto in a quiet rural setting near the northern ecotone of the deciduous forest association.

A number of international programs exist to support visiting scientists during their stay in Canada. The Quaternary Sciences Institute expects to direct and support applicants who might qualify for such programs.

For further details and information about the Quaternary Sciences Institute, please contact:

Director  
Quaternary Sciences Institute  
Department of Earth Sciences  
University of Waterloo  
Waterloo  
Ontario  
Canada  
N2L 3G1



## ARCHAEOLOGY UNDER ALLUVIUM: ARCHAEOLOGY AND THE RIVER ENVIRONMENT IN BRITAIN

3-5 January 1991

BRITISH MUSEUM

The view that rivers are agents of destruction has historically inhibited archaeological exploration of floodplains. Yet the same natural forces have led to the creation of some of the deepest sequences of sediment available for studies of past change. Work in recent years has shown not only that archaeological sites and fragments of their attendant landscapes can lie remarkably well preserved under the alluvium, but furthermore that the stereotype of marginal, regularly flooded land cannot always be assumed. **Archaeology under Alluvium** will look at the combined fruits of different disciplines, broadly archaeological, geomorphological and environmental.

Speakers from a wide variety of backgrounds will address such themes as the origins of alluvial material, causes of alluviation and interactions with human activity, the potential and limitations of archaeological data, and the interpretation of environmental remains. Contributors will include: Jenny Allsop, Nick Ashton, Ian Bailiff, Tony Barham, Martin Bell, Tony Brown, Paul Burrin, Tony Clark, Patrick Clay, Bryony Coles, John Coles, Jill Cook, John Dillon, James Dinn, John Evans, Charles French, M Keough, John Lewin, John Lewis, Simon Lewis, Susan Limbrey, Sue Lobb, Mark Macklin, Nick Merriman, Stuart Needham, Dave Passmore, Mark Robinson, Rebecca Roseff, Jim Rose, Chris Salisbury, Rob Scaife, Richard Tipping, Pat Wiltshire. Guest speaker on the Dutch experience of dealing with river archaeology: Professor Louwe Kooijmans.

Provisional programme:

**Thursday 3 January**, evening: Opening address.

**Friday 4 January**: Session 1 — Chemical, physical and biological characterisation of river depositional environments; Session 2: Dating of alluvial sediments; Session 3: Site-oriented studies.

**Saturday 5 January**: Session 4: Alluvial landscapes — upland and piedmont; Session 5: Alluvial landscapes — lowland; Session 6: Continental studies.

The conference is being organised by Stuart Needham and Mark Macklin. Further details from **Archaeology under Alluvium**, Prehistoric and Romano-British Antiquities, British Museum, Great Russell Street, London WC1B 3DG.

## NEW MEETINGS SUB-COMMITTEE

At the most recent (18 October) meeting of the Executive Committee, a proposal (by Mike Walker) to establish a Meetings Sub-Committee was approved. The new committee will be chaired by Clive Auton and comprise Richard Preece, David Bridgland and, as an ex-officio member Mike Walker, Secretary of the QRA.

The role of the new committee, as originally tabled by Mike Walker, will be to:

- i Co-ordinate proposals for future meetings and bring these forward to the Executive Committee for consideration and ratification.
- ii Draw up guidelines for organisers of meetings. Advice could be provided, for example, on the preparation of Field Guides (format, printers, etc.).
- iii Liaise with organisers and ensure that plans were progressing smoothly. Any problems could be picked up at an early stage and reported to the Executive.
- iv Arrange for meetings to be monitored. A report should be presented to the Executive on each meeting. Also arrangements should be made for the meeting to be reported in the *Quaternary Newsletter*.

In addition, the committee would have a proactive role in that it should be looking for new venues and themes for meetings, and it would be expected to bring forward to the Executive proposals based on initial contacts with possible future organisers.

## **CUMBERLAND GEOLOGICAL SOCIETY LECTURE PROGRAMME, NOVEMBER 1990 - MARCH 1991**

### **1990**

- November 14 Whitehaven, President Iver Gray on Australia.
- December 12 Keswick, Dr Richard Hughes of the BGS, on recent advances in the understanding of the Skiddaw Group.

### **1991**

- January 9 Cockermouth, to be announced.
- February 27 Workington, AGM and members evening.
- March 13 Whitehaven, Dr Dennis Jackson on hydrocarbon (oil and gas) exploration in the Irish Sea.
- April (Saturday) Annual Dinner, venue and speaker to be arranged later.

The programme arranged for this coming winter season places emphasis on Cumbrian topics. This is quite deliberate and while we have had some fascinating talks during the last few years, not many have focused directly on Cumbria. With many new members in the Society, we are trying to give an overall view of our area both in talks and the excursions. On the latter, it is planned to have one or more outings early in 1991 specifically for beginners and to demonstrate the fundamentals of geology in our very fascinating locale.

K W Bond  
Keswick CA12 4QA

## **FIELD VISIT TO POLAND, AUGUST 1991 Dr Peter Allen**

I am in the process of arranging an 8-10 day field visit to south-west Poland in late August 1991, together with Gail Ashley of Rutgers University, New Brunswick. We aim to have a party of c.8 people from Britain/Europe and 8 from the US. The visit will be led by Dr Darek Krzyszkowski of the University of Wrocław. I will be discussing details with Dr Krzyszkowski this November, but the visit will include the Belchatow outcrop, a graben that was still subsiding during the Quaternary, where excavations for brown coal have exposed a section 200 m (600') deep of Quaternary sediments, including six organic horizons in superposition ranging from the Cromerian to the Ipswichian. This site is extremely important for its stratigraphy and also has impressive sediments (tills, outwash, fluvial sands and gravels) and tectonic structures. The site was featured in Dr Krzyszkowski's article in the June issue of *Quaternary Newsletter*. Other sites likely to be visited are the Vistulian (Devensian) push moraines in the Leszno region and Quaternary alluvial fans in the Sudetan foreland. We would be amenable to trying to include sites you may suggest.

The cost is likely to be in the region of £350-400, comprising c.£200 air fare and c.£150-200 for 10 days' subsistence and accommodation.

If you are interested, please contact

Dr Peter Allen  
Department of Geography  
City of London Polytechnic  
Calcutta House  
Old Castle Street  
London E1 7NT

Tel. 071 283 1030 ext. 636 (messages 520/522)  
Fax. 071 623 2858

## QUATERNARY RESEARCH ASSOCIATION

### Awards to Young Research Workers 1991

#### 1 Purpose

To assist young research workers with fieldwork and/or excavation expenses, or to help to defray costs incurred by young research workers who are giving papers at conferences.

#### 2 Eligibility

Grants (not normally exceeding £100) will be made to postgraduate students who are currently registered for a higher degree and who are members of the Quaternary Research Association of at least one full year's standing. Preference will be given to those who have no source of fieldwork or conference funding, or whose access to such funds are limited.

#### 3 Applications

Applications (*two copies*) should be sent to the Chairman of the QRA Research Grants Subcommittee (see below). They should set out clearly the purpose for which the award is intended, and should contain full details of all sources of funding to which the applicant has access. The name of an academic referee, to whom the Subcommittee will make reference, should also be included. Applicants should note that these awards are essentially contributions towards research and would not normally be expected to cover the whole cost of a project/conference. The deadline for submission of applications is *March 15 1991*.

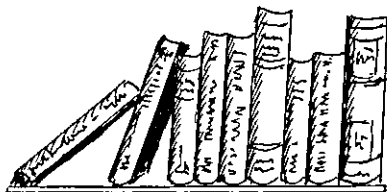
#### 4 Successful applicants

Successful applicants will be informed approximately four weeks after the AGM and will receive their grants shortly afterwards. Please note that successful applicants will be expected to submit a brief (300–500 word) report to the Subcommittee on the project for which the award was made that is in a style suitable for inclusion in the Quaternary Newsletter where it will appear, receipt of the grant should be acknowledged in any future publications, a copy of which should be sent to the Subcommittee.

Dr Peter Coxon  
Chairman, QRA Research Grants Subcommittee  
Department of Geography  
Trinity College Dublin  
Dublin 2  
Ireland



# Reviews



## ARCTIC ATLAS

Atlas Arktiki. Treshnikov, A F (editor) 1985, 204 pp. (152 pp. colour maps and legends, 52 pp. text). Size 590 x 370 mm. Moskva, Glavnoe Upravlenie Geodezi i Kartografi pri Sovete Ministrov S.S.S.R. In Russian, summaries in English.

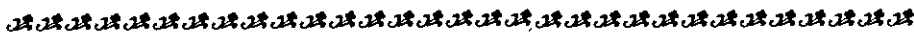
During a visit to Leningrad last year, I purchased for myself a copy of the above atlas from its producers, the Arctic and Antarctic Scientific Research Institute (AANI). On returning to England it became apparent that, although there was one at the Scott Polar Institute, there were few or no other copies here, in consequence of distributional problems, probably caused in part by its large size; yet there are certainly libraries and students of the Arctic who would expect to have their own. To help overcome this problem, a Soviet colleague visiting England in December brought a few additional copies, which have since been passed on to libraries. There is one in the General Library of the Natural History Museum (ref. BRN 74697), others in the British Library, and the libraries of the Geological Society of London, the Royal Geographical Society and Cambridge University.

Those concerned with distribution of the atlas from Leningrad would like to see more copies distributed here, but are uncertain how to arrange this. In addition, their Institute has need of a computer for its scientific work and I have undertaken to investigate the likely demand for further copies of the atlas here, the funds from which could then be put towards the purchase of one. The price of the atlas, if transport can be arranged, would be about £70 per copy. If anyone is interested in obtaining an atlas, would they please, in the first instance, get in touch with me, c/o The Natural History Museum, Cromwell Road, London SW7 5BD, telephone 071-938-9403 or (home) 081-546-7986. When I know how many are needed, I will try to arrange for further copies to be sent. This in turn would help our Soviet colleagues to get their computer!

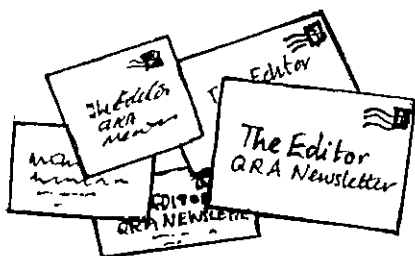
Concerning the atlas itself, this is divided into 13 sections — Introduction, geographical maps, history of discoveries and exploration, aeronomy and physics of the earth, geology, climate, types of synoptic processes and weather regime anomalies, hydrology, glaciation and permafrost, soil-vegetation cover, fauna, physico-geographical regionalisation, population and economy. There are approximately 350 colour maps which vary in size from double page to 12 on a page. These are mostly polar projections with the Soviet Union at the bottom and, the southern tip of Greenland at the top. There are also some more detailed maps of selected areas, including the New Siberian Islands, Severnaya Zemlya, Novaya Zemlya, Franz Josef Land, Spitzbergen, Greenland and the Canadian Arctic. There are ten pages of distribution maps of mammals, birds, fish and invertebrates. The atlas is well printed, on good quality paper, and well bound, with a hard cover. It would not be out of place on a coffee table — that is anyone has a coffee table sufficiently large!

An additional aspect of this contact with the Arctic and Antarctic Research Institute that seems important is the potential that it offers for better communication and possible exchanges between Soviet and Western scientists concerned with Arctic studies. AANI staff have a fascinating programme of research in hand in the north, including on Severnaya Zemlya and the New Siberian Islands, most of which is being published in Russian. They would like to see more of this published in English (any interested editors?) and they would like closer contact with their English-speaking equivalents. Let us hope that this can be one of the products of glasnost.

Antony Sutcliffe



# Post Bag



Dear Editor

I would like to comment briefly on three articles of your 6/90 No. 61, issue.

## 1 Hall and Bent, 1990

The authors propose a N-S orientated late Weichselian ice limit running between  $1^{\circ}$  and  $2^{\circ}$ W from  $56^{\circ}$  to  $59^{\circ}$ N, with glacial marine deposits to the east. They neglect the significance of the numerous bathymetric deeps with their underlying incisions that occur in the area. These deeps are orientated SW-NE at  $56^{\circ}$ N  $01^{\circ}$ W. E-W at  $58^{\circ}$ N  $01^{\circ}30'$ W and thence NW-SE along a trend to the NE to  $59^{\circ}$ N  $01^{\circ}30'$ E (Flynn, 1967, 1973; Jansen, 1976; Wingfield, 1989). Although the mechanism of major incision formation is controversial, current research is agreed that formation occurred within an ice sheet margin (Boulton and Hindmarsh, 1987; Wingfield, 1990; Hamblin et al., in press a,b). Long and Stoker (1986a,b) recognised that enclosed bathymetric deeps (open channels) were only associated with Weichselian major incisions. The incisions therefore suggest that the late Weichselian ice margin bordered the glacial marine muds of the Witch Ground Basin (Long et al., 1986), to the east and SE of the limit proposed by Hall and Bent (1990).

## 2 Maizels and Russell, 1990a

The authors question the term catastrophic when applied to the numerous, but intermittent jökulhlaup flood drainages during the Pleistocene. Wingfield (1989) estimated that some 1000 jökulhlaup floods had evacuated the late Elsterian (c.400), late Saalian (c.200) and late Weichselian (c.400) major incisions identified on the continental shelf off Britain. Each flood may have discharged between 50 and 200 cubic kilometres of meltwater in less than two hours (Wingfield, 1990; Pantin and Wingfield, in preparation). Whether such floods should be considered as catastrophes, or merely intermittent "peak" events in flow-pattern, surely depends on their frequency? In the Devil's Hole area of the central North Sea (Graham, 1985) there is an exceptional concentration of 12 major incisions orientated N-S over an E-W distance of 60 km. These are late Weichselian major incisions with enclosed deeps (Wingfield, 1990); thus the incision-forming jökulhlaups occurred over at most 15 ka or possibly as little as 5 ka. Even this latter span represents an average flood interval of over 400 years, an interval which would represent more than 16 generations (each from 20 to 25 years) to an Inuit-type hunter culture. The floods would have been catastrophes in human terms.

## 3 Maizels and Russell, 1990b

I applaud the call by the authors to reassess the role of large-scale floods in the UK Quaternary. BGS holds an extensive data bank across the continental shelf delimiting major incisions, which may represent jökulhlaup plunge pools (Wingfield, 1990). Since the continental shelf generally lacked the topography to have allowed the accumulation of ice marginal lakes, I have suggested that the dominant process of meltwater releases occurred as floods from intra-ice-sheet lakes and not from ice marginal lakes. These discharges were largely through open channels (Pantin and Wingfield, in preparation), rather than by the mechanisms itemised by the authors.

Yours sincerely,

Robin Wingfield  
Marine Surveys (South)  
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Keyworth  
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## ACKNOWLEDGEMENTS

This letter is published with the permission of the Director, British Geological Survey (NERC).

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- Pantin, H M, and Wingfield, R T R.** In preparation. Drainage of large intra-glacial lakes: outflow velocities, channel enlargement and consequent erosion.
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- 1990. The origin of major incisions within the Pleistocene deposits of the North Sea. *Mar. Geol.*, **91**: 31-52.

Dear Dr Taylor

The article by D Krzyszkowski "Hoxnian versus Ferdynandovian . . ." published in the Quaternary Newsletter No. 61 provoked us to discuss some geological aspects of that paper.

To begin with a truism, namely that any serious discussion on the stratigraphic position of a paleobotanic site must be accompanied by a clear picture of the geological situation of that site. We wonder whether the situation concerning the type locality of the "Ferdynandovian Interglacial" is clear to the reader from the few sentences in the section "Position of the Ferdynandovian Interglacial" (page 26 of the discussed paper). Apart from the vagueness of the text—not supported by a geological profile or section—Krzyszkowski does not mention those papers giving a quite different stratigraphic interpretation of the site (e.g. Ruszczynska-Szenajch, 1978). Concerning the geology of another site (Belchatów) discussed in the paper, the detailed stratigraphy given on Fig. 4 is by no means satisfactorily illustrated by fig. 3 referred to by the author. Therefore, the geological background of the problem discussed is both vague and incomplete.

The reader may also find a more general problem when looking at the stratigraphic table shown on Fig. 1 in the discussed paper. Anybody from abroad acquainted with the Quaternary stratigraphy in Poland—and numerous Polish Quaternary researchers as well—must be very much astonished by a flood of new stratigraphic names and units.

The stratigraphic subdivisions and terminology of Quaternary sediments in Poland was presented for a wide international audience during the INQUA Congress in Poland by Professor S Z Różycki (1961). This subject was then completed and published in Polish as a thorough and comprehensive book (Różycki, 1972) which contained a discussion of detailed studies as well as broad correlations. The terminology of the main stratigraphic units used by Różycki corresponds to the long-used terms in Poland, according to generally accepted custom in stratigraphy. This terminology has been widely used by Polish Quaternary researchers.

During the last decade, a strange phenomenon has spread into Polish Quaternary literature. L Lindner (1984) published many new stratigraphic names instead of the terms used previously. The use of these new terms in the following years has been regarded by some Quaternarists as a very "modern" approach to the question; however, this met with a reaction expressed in oral discussions during scientific meetings in Poland. As a matter of fact, it was not very seriously treated by many researchers. However, the negative consequences of the phenomenon are currently being observed in geological mapping and in teaching programs and are being compared with the consequences of introducing a kind of stratigraphic "newspeech".

D Krzyszkowski probably fell victim to an uncritical acceptance of the 'newspeech'. However, his article has elevated a 'domestic' problem into a wider issue: such a situation has urged us to write this letter as well as begin preparing for publication a more thorough discussion concerning the approach to Quaternary stratigraphy in our country.

Hanna Ruszczynska-Szenajch  
Dept of Geology  
Warsaw University  
Poland

Tadeusz Wysoczański  
Inst. of Geol. Sciences  
Pol. Acad. of Sciences  
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Dear Sir

David Bridgland (QN 60, p.10) is correct about the lithological basis of formation mapping. Fortunately, however, "recognisable in the field" will remain a subjective criterion which can thoughtfully be adapted to circumstances. Woe betide the geological mapper who lumps adjacent Devonian and Permian rocks into a single formation of, say, red sandstone. In such circumstances we effect a division *in the field* on the basis of relatively minor bed characteristics, including clast lithology.

In his own excellent work on the Essex gravels, Bridgland (1988) found it possible to do more than to lump adjacent terrace sands and gravels as single units (cf. QN 60, p.11). Indeed, most of his mapped gravel formations show a very satisfying, thoughtful fit between bulk lithology, clast lithology and terrace morphology.

**Bridgland, D R.** 1988. The Pleistocene fluvial stratigraphy and palaeogeography of Essex. *Proc. Geol. Assoc.* 99 (4), 291-314.

Peter Banham  
11 Aylward Gardens  
Chesham  
Bucks





**THE HOLOCENE—AN INTERDISCIPLINARY JOURNAL FOCUSING ON  
RECENT ENVIRONMENTAL CHANGE**

A leaflet giving details of this major new journal is included with the current Circular. Please note that Quaternary Research Association members are entitled to subscribe at the privileged personal rate of £27.50 (as opposed to the stated rate of £30.00). It would greatly assist the publishers, Edward Arnold, if members wishing to subscribe at this *special rate* would include the initials QRA next to their names on the order form.

## Notes

## 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. Most members reside in Great Britain, but membership also extends to most European countries, North America, Africa and Australasia. Current membership stands at c.1000. Membership is open to all interested in the objectives of the Association. The annual subscription for ordinary members is £10.00 and is due on January 1st for each calendar year. Reduced rates apply for students, unwaged and associated members.

The main meetings of the Association are the Annual Field Meeting, usually lasting 3 or 4 days, held in April, and a 1 or 2 day Discussion Meeting held at the beginning of January. Additionally, Short Field Meetings may be held in May or September and occasionally these visit overseas locations. Study Courses on the 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 November, the *Journal Science* published in association with Longmans, and with three issues a year, 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 course of the April field meeting. The current officers of the Association are:

- President: Professor J Rose, Department of Geography, Royal Holloway and Bedford New College, University of London, Egham Hill, Egham, Surrey TW20 0EX
- Vice President Professor W A Watts, Provost's House, Trinity College, Dublin 2, Ireland
- Secretary Dr M J C Walker, St David's University College, Lampeter, Dyfed, Wales SA48 7ED
- Assistant Secretary (Publications): Dr D R Bridgland, 41 Geneva Road, Darlington, Co Durham DL1 4NE
- Treasurer: C A Whiteman, Botany School, University of Cambridge, Downing Street, Cambridge CB2 3EA
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- Editor (*Journal of Quaternary Science*): Dr P L Gibbard, Botany School, University of Cambridge, Downing Street, Cambridge CB2 2EA

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