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NUMBER 99

FEBRUARY 2003

# QN

Quaternary Newsletter

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*A publication of the*  
Quaternary Research Association

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# QUATERNARY NEWSLETTER

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## Instructions to authors

*Quaternary Newsletter* is issued in February, June and October. Articles, reviews, notices of forthcoming meetings, news of personal and joint research projects, etc. are invited and should be sent to the Editor. Closing dates for submission of copy (news, notices, reports etc.) for the relevant numbers are 1<sup>st</sup> January, 1<sup>st</sup> May and 1<sup>st</sup> September. These dates will be strictly adhered to in order to expedite publication. **Articles must be submitted at least 6 weeks before these dates in order to be reviewed and revised in time for the next issue of QN, otherwise they may appear in a subsequent issue.**

Suggested word limits are as follows: obituaries (2000 words); articles (3000 words); reports on meetings (2000 words); reports on QRA grants (500 words); reviews (1000 words); letters to the Editor (500 words); abstracts (500 words). Authors submitting work as Word documents that include figures must send separate copies of the figures in .eps format. Quaternary Research Fund and New Research Workers Award Scheme reports should limit themselves to describing the results and significance of the actual research funded by QRA grants. The suggested format for these reports is as follows: (1) background and rationale (including a summary of how the grant facilitated the research), (2) results, (3) significance, (4) acknowledgments (if applicable). The reports should not (1) detail the aims and objectives of affiliated and larger projects (e.g. PhD topics), (2) outline future research and (3) cite lengthy reference lists. No more than one figure per report is necessary. Recipients of awards who have written reports are encouraged to submit full-length articles on related or larger research projects.

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Argraff/Printed by:

Gwasg Ffroncon Press

BETHESDA

Gwynedd, North Wales

Tel: 01248 601669 Fax: 01248 602634.

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## COVER PHOTOGRAPH:

Head of the Gaddagh Valley, Macgillycuddy's Reeks, Eire. Photograph kindly supplied by Jonathan Lageard (see report on QRA Short Field Meeting).

# OBITUARY

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## HUW IDWAL GRIFFITHS

1958 – 2002

The untimely death of Huw Griffiths on 12 June 2002, following a short illness, has robbed the world of zoology and palaeozoology of a gifted, highly vocal and extremely energetic scientist.

Huw Griffiths was born in Lincolnshire in 1958. Despite showing an early interest in the natural world, he did not immediately enter university following secondary school, but rather embarked on a wide range of jobs. During his early to middle twenties, he worked in, amongst other things music, manual labour and interior decorating. Finally, at the age of 27, he entered the world of higher education, and was awarded a 1<sup>st</sup> class honours degree in Zoology in 1988, by the University of Wales. After graduation, he studied for an MPhil on badger conservation in the School of Pure and Applied Biology at the University of Wales, Cardiff, submitting his thesis in 1992. Even before finishing his MPhil, Huw embarked on a PhD project on freshwater ostracods in the School of History and Archaeology: his thesis, an encyclopaedic piece of work displaying great depth and breadth of knowledge, was submitted and successfully defended in 1995. These two pieces of work exemplify the breadth of Huw's interests within the natural sciences. The fact that they were undertaken during employment as a research technician and research assistant, respectively, rather than through the tenure of studentships, also reflect the fact that Huw tended to do things differently from the norm. Huw took up a research associate post in the department of Genetics, University of Leeds, to work on the genetics of non-marine ostracods in 1992 and then obtained a permanent lectureship in the Department of Geography, University of Hull in 1995; he was promoted to Senior Lecturer there in 2000.





Huw was a scientist of considerable energy. Not content with specialising in a single branch of science, Huw had interests, expertise and authority in several. I knew and collaborated with Huw the ostracod worker. He was involved in a wealth of projects on, amongst other things, ostracod biology, ecology and palaeoecology and worked in Britain and overseas. Huw was often the first port of call for help with ostracod identification and developed specific skills of identification from their shells (which tend to be preserved in Quaternary sediments) rather than their body parts (which do not). Not surprisingly, the traffic of specimens to Hull tended to be heavy. Huw's other scientific side was concerned with vertebrate ecology; his publication record indicates how active he was in both areas of science. In addition to writing, Huw undertook a number of challenging editorial roles, and, in particular, took very seriously the task of helping non-native-English writers to write in English.

Huw's move to the permanent staff in Hull gave him the opportunity to teach. His students regarded him as a brilliant, inspirational and theatrical lecturer. Not only did he strive to teach them in the best possible way, Huw also showed great concern for their welfare. In addition to undergraduate teaching, Huw supervised a number of MPhil and PhD projects in a very wide range of subjects, including mammal ecology, aquatic biology and palaeoecology.

As well as being highly energetic, Huw always had something to say. I remember visiting the Royal Belgian Institute of Natural Sciences some years ago. Over coffee, one of the scientists mentioned to my host that I was rather quiet: my host explained that I was a visitor from the UK who spoke limited French and no Flemish. This led the scientist to remark that my host had had another visitor from UK several weeks before whose lack of knowledge of French and Flemish had not prevented him from saying a great deal! That visitor was, of course, Huw.

Given Huw's all-too-short scientific career, his bibliography is extremely impressive. What is clear, however, is that his scientific potential had not been fully realised. Although he left number of unfinished manuscripts that will eventually be published, sadly too many of his large stock of ideas and plans will not see the light of day. It is perhaps highly characteristic of Huw that very few people other than those closest to him knew how ill he was. He continued to work until shortly before he died and, outwardly at least, displayed an optimistic attitude to a very serious illness. Huw is survived by his wife, Dr Jane Reed, who is a diatomist, and by their three-year-old son, Thomas. He will be greatly missed by all those who knew him.

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# ARTICLES

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## SCHOOLS AND UNIVERSITIES: A CASE OF 'MIND THE GAP'?

Della K. Farrow

### Introduction

Travelling on the London underground used to be a dangerous exercise as you were forever being warned to 'mind the gap'. It might be argued that in today's research-driven environment this analogy can be applied to most academics' knowledge of schools' curricula - which includes aspects of Quaternary science embedded in the geography courses - and students' prior learning. Although awareness of the research of some Quaternary scientists is increasing through greater prominence in the media, it is important that all academics maintain an interest in the portrayal of their discipline in schools. Later discussion will highlight potential disparities in students' exposure to Quaternary science.

Previously, universities such as London or Oxford were responsible for determining both the examination syllabi (now termed specifications) and assessments that resulted in academic qualifications. Increasing regulation by successive governments, driven by the perceived need to standardise the examination content and additionally to offer vocational qualifications, has led to the amalgamation of these examination boards with vocationally driven examination bodies. Now there are just four: Assessment and Qualifications Alliance (AQA), Educational Excellence (Edexcel), Oxford Cambridge and RSA Examinations (OCR), and Welsh Joint Education Committee (WJEC). In terms of GCE geography qualifications each examination board, with the exception of WJEC, offers two specifications, A and B. With respect to physical geography the former focuses on processes while the latter emphasises geographical issues such as water resource management. Standardisation within the examination courses has been achieved through implementing core subject content, similar to the benchmarks appearing in university geography degree programmes.

Of particular interest to QRA academics is the extent of students' prior experience and understanding of Quaternary chronology. Is their knowledge limited to coverage of the subject in the media, or can academics expect students familiar with, for example, ice-core stratigraphy and oxygen-isotope stages? This article outlines the recent changes to the post-16 examination courses and discusses the impact that such changes might have on the QRA. It concludes by suggesting how the QRA can develop its liaison with schools/further education colleges.

## **Changes to post-16 education**

In 1999 David Blunkett, then Secretary of State for Education, announced revisions to the content and structure of the National Curriculum, which encompasses post-16 education. As the revised curriculum became statutory in August 2000 it was termed Curriculum 2000. The aim of Curriculum 2000, with respect to post-16 education, was to improve and broaden the education of 16-19-year-olds by replacing A levels with AS and A2 examinations, collectively comparable to the overall standard of the former A level. In this manner it was anticipated that students would study at least four subjects to AS before continuing with three of them in year 13. Students have the option (decided by their institution) of sitting their AS level examinations in the summer of year 12 before progressing to the A2 courses. Alternatively students may sit all of the examinations at the end of year 13, although this is not usually the preferred route. Whichever assessment route is followed the AS is worth 50% of the total mark yet assessed at a standard between GCSE and A level. Consequently the A2 examinations should be more rigorous in order compensate for the 'easier' AS ones.

In addition to AS levels, students have the option of undertaking a key skills course where they have to demonstrate competency in communication, application of number and information technology through coursework and external examination. This culminates in a key skills qualification. Despite being awarded UCAS points, this qualification is not popular with students, who consider it an unnecessary addition to an already high AS workload. This is exacerbated by a lack of recognition from higher education admissions tutors regarding the status of the qualification (QCA, 2001).

## **Discussion**

The first cohort of Curriculum 2000 students began their undergraduate courses in October 2002. Of relevance to QRA members the level to which aspects of the discipline are listed in the six examination specifications. In other words to what extent will students' interest have been stimulated, and will they all start their courses with the same baseline knowledge? Certainly topics that encompass the Quaternary are taught in year 13, when it is expected that students will have substantiated their critical thinking skills and so can handle the abstract issues. On the surface the prognosis is good. Four of the six specifications have reference to climate change explicitly within the context of glacial-interglacial cycles, with OCR B specification even referring to Milankovitch cycles! However there is a worrying, albeit minimal, use of terminology that has the potential to mis-lead both teacher and student. For example, the AQA B specification refers to the 'Pleistocene Ice Age' when discussing major climatic fluctuations in temperature and precipitation in the British Isles. Presumably this is referring to the Late Devensian glaciation, and its singular use implies that the British Isles only experienced one glaciation during the Pleistocene. Increased consultation and involvement of Quaternary scientists in future specification design should eradicate such oversights.

Furthermore Table 1 shows that students have the potential to experience and develop an in-depth understanding of Quaternary science, although it should be noted that each individual specification does not incorporate all of the topics listed. However increased competition for curriculum time, for example from key skills, reduces students' experiences of Quaternary science as the time allocation for each A2 is squeezed. In order to overcome this, all geography A2 units contain optional elements, at the discretion of the teacher's strengths or interests. Consequently more appealing and exciting topics such as coastal management or geomorphic hazards are often selected rather than a cold environments or glacial unit. Most teachers themselves have a limited knowledge of the intricacies of Quaternary science, which when combined with burgeoning workloads, reduce the time that they can commit to researching unfamiliar topics. Paucity of students' knowledge may be entirely the result of teacher, rather than student choice. Therefore increased liaison is required between the QRA and schools to improve awareness of the research activities of the QRA and its members, and to ascertain how these activities link to the new Curriculum 2000 specifications so that teachers can be persuaded to teach these topics.

Prior to the implementation of Curriculum 2000 Lawson (2000) identified the QRA website as a medium through which teachers or students could access cutting-edge research. He envisaged a web page containing a British Isles map sub-divided into regions, each containing a summary of the Quaternary of that region together with local case studies. In addition he suggested the development of a schools' link page through which teachers could contact supportive academics. However other requirements are perhaps more fundamental: a definition of the terminology used by Quaternary scientists, and downloadable maps or diagrams. For example, such maps could depict the changes in the extent of ice cover during the Pleistocene glacial-interglacial cycles in the British Isles, while sketches could summarise how Milankovitch theory influences climate change. These ideas, and others, have the potential to be successful only if (a) teachers are aware of the expertise available including, fundamentally, the existence of the website; and (b) QRA members are willing to offer their time to produce the documentation, which would need to correspond to the subject content of the specifications in order to be of significant benefit to teachers.

### **Developing liaisons with schools**

One method of publicising the website could be through the publications of the Geographical Association, or an A-level student journal such as *Geography Review*. As Table 1 highlights, there are significant contributions that the QRA can make in developing understanding of Quaternary science in the teaching community. As most teachers have limited access to university libraries and scientific journals, a schools' link page is an ideal means of communication. On these pages there could be summaries of relevant academics' work together

Topic	Specification description
1. Evidence for, and causes of climate change and global warming	<ul style="list-style-type: none"> <li>reconstructing glacial and post-glacial conditions since the early Pleistocene using ice cores, isotopes, pollen, marine sediments and varve analyses</li> <li>evidence of climate change through radiocarbon dating and the archaeological record</li> <li>the influence of Milankovitch cycles, ice albedo effects and volcanic activity in changing climate</li> <li>past climate change in hot arid and semi-arid environments</li> <li>global warming and its possible influence on environments and human activities</li> </ul>
2. Glacial landforms and	<ul style="list-style-type: none"> <li>the extent of ice cover in the British Isles during the Pleistocene glacial and interglacial cycles</li> <li>landforms of modern glaciation (ice sheets and valley glaciers) that can be recognised in previously glaciated areas such as the Lake District or Snowdonia</li> <li>the effects of deglaciation on the landscape, resulting in the diversion of drainage, ice spillways/overflow channels, and pro-glacial lakes</li> </ul>
3. Glaciofluvial landforms and processes	<ul style="list-style-type: none"> <li>the characteristics and distribution of glacio-fluvial outwash plains, kames, eskers and kame terraces</li> <li>the extraction of glacial and glaciofluvial deposits by the construction industry (and subsequent reclamation)</li> </ul>
4. Human evolution (Edexcel Biology)	<ul style="list-style-type: none"> <li>the influence of evolution on hominid features</li> <li>evidence for, and characteristics of, evolution during Neolithic and Palaeolithic times by comparing and dating fossil material</li> </ul>
5. Palaeontology (OCR Geology)	<ul style="list-style-type: none"> <li>the description and use of trace fossils and fossil assemblages in interpreting palaeoenvironments</li> </ul>
6. Periglacial landforms and processes	<ul style="list-style-type: none"> <li>the distribution of periglacial environments in Western Europe during the Quaternary</li> <li>the nature of permafrost and its influence on hydrological and surface processes</li> <li>the significance of the active layer, ground ice, frost sorting, solifluction and surface wash in producing solifluction lobes, patterned ground, pingos, ice wedges, thermokarst and alases</li> <li>relict features in the UK and north west Europe, and active features in Canadian Northlands</li> </ul>
7. Sedimentary sequences (OCR Geology)	<ul style="list-style-type: none"> <li>characteristic features and palaeoenvironmental significance of cross bedding, ripple marks, graded bedding and dessication cracks</li> <li>litho-, bio- and chronostratigraphic methods of correlation, including volcanic ash layers</li> </ul>
8. Sea-level change	<ul style="list-style-type: none"> <li>changes in base level resulting from isostatic and eustatic changes</li> <li>coasts of submergence and emergence: rias, fjords, raised beaches and relict cliff lines</li> </ul>
9. Seral succession	<ul style="list-style-type: none"> <li>energy flows and nutrient cycling of a hydrosere (e.g. peat bog), and changes over time</li> </ul>

**Table 1.** A summary of the links between the research activities of the QRA and the Curriculum 2000 Geography, Geology and Biology specifications. Unless stated all specifications refer to geography. All of the specifications are downloadable in pdf format from each examination board's website if any QRA member wishes to read the comprehensive version

with hyperlinks to further information, for example reports of field or discussion meetings. Monitoring the 'hit rate' to the schools' link page would provide an indication of the effectiveness of these advertisements, perhaps even increasing subscriptions!

An important niche that can be exploited by the QRA is the publication of up-to-date case study material (Lawson, 2000) that either supplements those described in the course textbooks or provides new site descriptions; recently published textbooks correspond to a particular AS/A2 specification and often lack sufficient detail for students to attain a high grade. Some members have already contributed to student journals (e.g. Walden, 1992; Warren, 1995; Anderson, 2000; Evans and Benn, 2001), and these have been warmly received. However as Table 1 illustrates, there is the potential for a plethora of review articles that match the requirements of the new specifications.

The introduction of Curriculum 2000 provides an opportunity for the QRA to widen its scope and develop partnerships with the secondary educational body. Students are intrinsically interested in the causes and processes associated with climate change, and therefore the QRA has a key role to play in furthering that curiosity.

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The constructive comments of the two referees improved the text.

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### **Examination Boards' web addresses**

[www.aqa.org.uk](http://www.aqa.org.uk)    [www.edexcel.org.uk](http://www.edexcel.org.uk)    [www.ocr.org.uk](http://www.ocr.org.uk)    [www.wjec.co.uk](http://www.wjec.co.uk)

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## SOME OBSERVATIONS ON RECENTS IDEAS ABOUT THE TEIFI VALLEY, WEST WALES

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Recent publications on the Teifi Valley, west Wales, reinterpret earlier work. It is important to balance their arguments because they are not invariably based on a complete knowledge or understanding of the previous literature, as outlined below.

### **The raised shore platform and deposits at Poppit Sands and Gwbert**

It is recently contended that the platform just above high water, previously interpreted as a raised marine platform (Jones, 1965; Bowen, 1973; Bowen and Lear, 1982, 1986; Campbell and Bowen, 1989), was fashioned by glacial erosion (Etienne *et al.*, 2001; Glasser *et al.*, 2001). In advocating this, they follow the view first published by Eyles and McCabe (1989), and they are apparently unaware of the details of a range of indicators that point to a marine origin, including the uniform elevation of the platform on both sides of the estuary.

Particle size, stone roundness and foraminiferal analyses were undertaken at three sites of raised-beach deposits over a distance of approximately 350 m (Lear, 1986), whereas the description of Etienne *et al.* (2001) is based on only one of these (SN 146489), where 1.6 m of manganese- and iron-stained gravel, sands and silt occur. The particle-size parameters, however, were considered to be different beach lithofacies representing bottom sediment in the breaker zone, suspended sediment in the breaker zone and suspended sediment in the surf zone (Lear, 1986). Similar lithofacies variability may be seen on many contemporary beaches in west Wales. Furthermore the high Cauilleux roundness index of over 300 cobbles is consistent with the high rates of attrition in a coastal environment (Lear, 1986).

Some 200 m to the southeast (SN 148489), 50 foraminifera, identified by Professor J.R. Haynes (Lear, 1986), were recovered from 0.4 m of laminated silty clay, which overlay 0.35 m of cobbles in a clay matrix resting on the shore platform. This silty clay was interpreted as marsh sediments. Neither Etienne *et al.* (2001) nor Hambrey *et al.* (2001) consider the foraminiferal species identified as important and instead simply claim that they were due to a 'subsequent ingress of marine water' after a jokulhlaup had emptied glacial lake Teifi (Etienne *et al.*, 2001), or that the foraminifera in their glaciofluvial gravels were derived (Hambrey *et al.*, 2001).

The foraminiferal evidence cannot be so conveniently dismissed. Some 70% of the foraminifera were temperate varieties, and 26% identified as *Elphidium crispum*. *Elphidium crispum* is not currently found in Cardigan Bay or anywhere north of the English Channel (J.R. Haynes, *pers. comm.*). Furthermore its predominance and other species is similar to the assemblage identified by Jasin (1976) from the 'interglacial' sands and gravels lying between two till units (Garrard, 1977) recovered from IGS boreholes in Cardigan Bay.

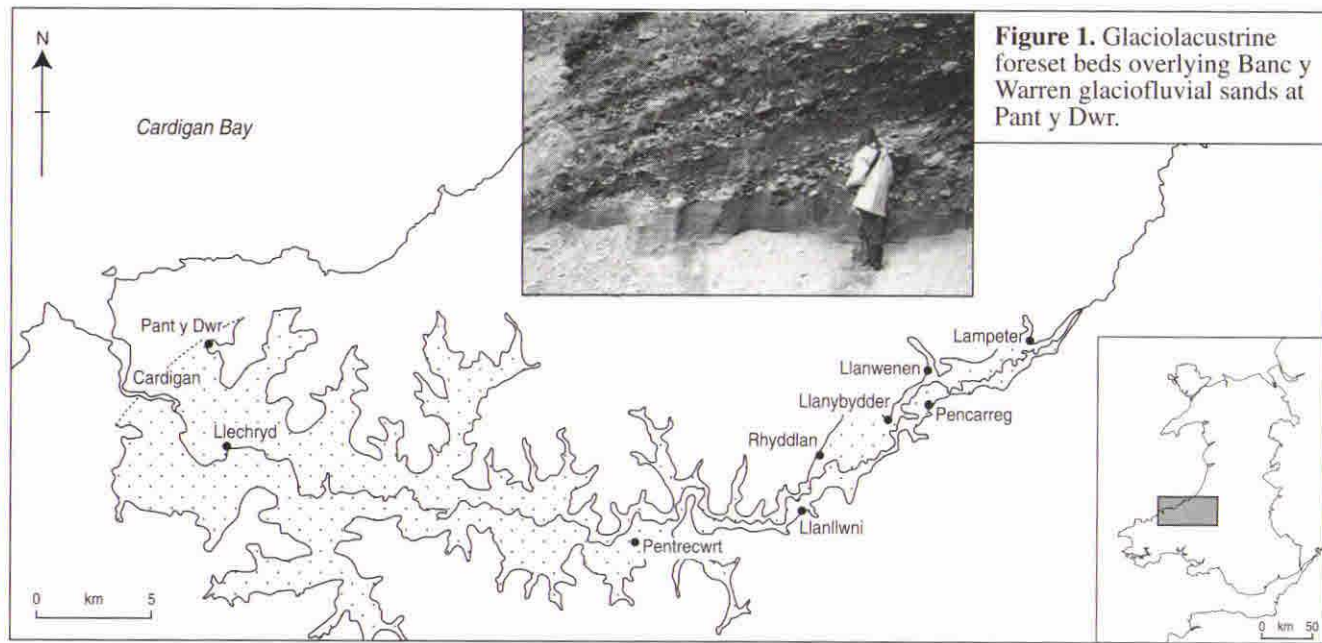
The interglacial nature of the Poppit sediments is further upheld by lithostratigraphical correlation with similar sediments in Pembrokeshire, Carmarthen Bay and Gower (Bowen, 1973). A similar foraminiferal assemblage from the 'Outer Beach' at Minchin Hole, Gower (Henry, 1984) to that at Poppit led Lear (1986) to correlate them on biostratigraphical grounds. Aminostratigraphical correlation of the 'Outer Beach' with Bacon Hole Cave sediments containing speleothem with mean U-series ages of 122 ka (Stringer *et al.*, 1986; Bowen, 1999) confirms further correlation with Oxygen Isotope Substage 5e. This is added to by an amino-acid ratio, interpreted as corresponding to an age of 120 ka, from the 'interglacial' sands and gravels in BGS borehole 89/10 in the Irish Sea (Tappin *et al.*, 1994), that is correlated on lithostratigraphical grounds with the interglacial gravels in the boreholes described by Garrard (1977).

On the eastern side of the Teifi estuary Glasser *et al.* (2001) and Hambrey *et al.* (2001) identify basal till, thus confirming the interpretation of Lear (1986) at Patch. At Craig y Gwbert (SN 159501), Glasser *et al.* (2001) and Hambrey *et al.* (2001) describe up to 4 m of gravels consisting of a lower 'angular' gravel believed to an ice reworked head deposit and an upper more rounded 'boulder gravel' believed to be a reworked ice-contact deposit. On the other hand, Lear (1986) recognised no such division and interpreted the gravels as glaciofluvial outwash with westerly directional data at two nearby gravel pits, supporting his view that current direction ran from the vicinity of Banc y Warren.

### Glacial Lake Teifi

The existence of a glacial lake Teifi was first suggested in a lecture given at Aberystwyth by O T Jones in 1928 and a brief summary was published in the local press. Charlesworth (1929) and Jones believed that the lake developed during deglaciation. The BGS drilling programme in the Cardigan area has yielded extensive lacustrine deposits in four boreholes. These were used to infer that the lake formed as a result of ice advance rather than retreat or ice decay (Fletcher and Siddle, 1998; Hambrey *et al.*, 2001).

The lithostratigraphical evidence does not invariably support this interpretation. The relatively late existence of glacial Lake Teifi is suggested by the distribution of laminated lacustrine clay at numerous sites throughout the lower Teifi



**Figure 2.** The extent of Glacial Lake Teifi and associated glaciolacustrine deposits.

Valley, especially on the floodplain flanks and in the tributary valleys (Lear, 1986). The Llechryd gravel pit (SN211436), type-site of the Llechryd Formation (Lear, 1986), contains laminated, varve-like deposits (Williams, 1927) that overlie more than 5 m of glaciofluvial gravels described by Jones (1965), Bowen (1967) and Lear (1986), that were not mentioned by Hambrey *et al.* (2001). Lear's (1986) particle-size analysis was estimated to represent about 40 years of sedimentation. At four other locations in the Teifi Valley calcium carbonate was found in the lacustrine clays, thus suggesting derivation from the calcareous 'Irish Sea Till'.

Lacustrine foreset beds at Pant y Dwr (SN 205484) that overlie the Banc y Warren sands and gravels north of Cardigan were identified by Jones (1965) and represent the uppermost unit described by both Helm and Roberts (1965) and Allen (1982). Within these beds are some 20 pairs of coarse and fine gravel beds which Lear (1986) interpreted as seasonal deposits (Figure 1). The foresets at Pant y Dwr are at an altitude of about 126 m O.D., which is the same as those in the delta deposits at Rhyddlan, Llanybydder, Llanwnen, Pencarreg and Lampeter, up to 60 km to the east (Figure 2). Perhaps the most telling evidence of the late formation of the lake is the delta at Pentrecwrt (Jones, 1965), where its deposits overlie the Pentrecwrt Till (Bowen, 1974, 1999).

The altitude of a glacial lake may be shown reliably only by the upper surface of deltas and by lake shorelines. In the case of glacial Lake Teifi the delta height at Pant y Dwr, Rhyddlan, Llanybydder, Pencarreg and Lampeter is about 126 m O.D. Hambrey *et al.* (2001) use the altitude of the 'overflow' channels at Cippyn (105 m) and Llantood (120 m), as did Charlesworth (1929) and Jones (1965), but until the debate over their origin (overflow or subglacial?) is finally resolved, their palaeoenvironmental significance remains uncertain. The evidence of the deltas at 126 m is clear, and Jones (1965) also identified a possible shoreline at the same elevation at Llanllwni. It seems clear that the evolution of glacial Lake Teifi was more complex than that suggested in a simple model of ice advance and lake formation.

It is unfortunate that these recent publications cited in the QRA field guide (Walker and McCarroll, 2001) and the West Wales special edition of the *Journal of Quaternary Science* (volume 16(5) 1999) have failed to consider all of the available palaeoenvironmental evidence.

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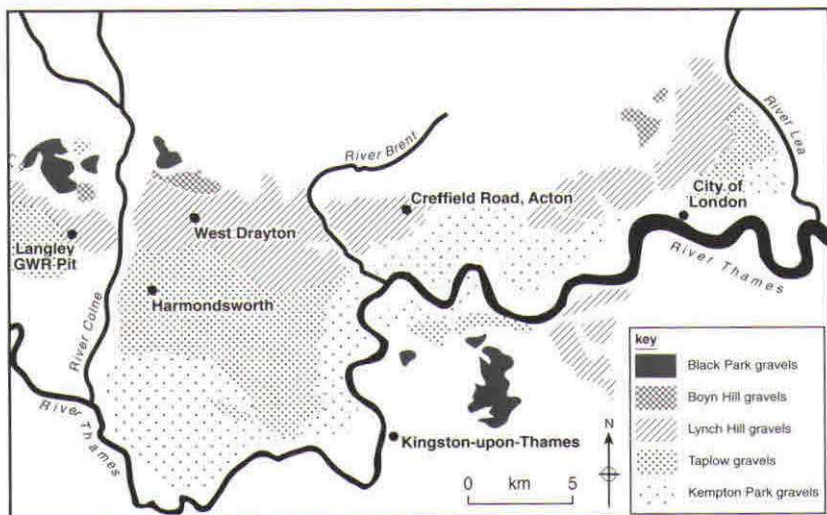
# THE DATING OF LEVALLOIS SITES IN WEST LONDON

Nick Ashton, Roger Jacobi and Mark White

## Introduction

West London has long been noted for the occurrence of a number of sites and find-spots that include Levallois technology (Brown, 1887, 1895). Although there are 28 find-locations, they are dominated by just four sites: Creffield Road in Acton; and Boyer's, Sabey's and Eastwood's Pits in West Drayton (Figure 1). Taken together, the west London area contributes a significant proportion of known British Levallois artefacts, the only other major sites being Baker's Hole (Smith, 1911; Wenban-Smith, 1995), Crayford (Spurrell, 1880; Cook, 1986; Bridgland, 1994), Pontnewydd (Aldhouse-Green, 1995), Lion Pit Tramway Cutting (Hinton and Kennard, 1900; Bridgland, 1994), Brundon (Moir and Hopwood, 1939; Wymer, 1985), Bapchild (Dines, 1928) and New Hythe Lane (Roe, 1968, 167).

Most of these other sites have been attributed to the later part of Oxygen Isotope Stage (OIS) 8 or to OIS 7 (Table 1), but many of the west London sites seem difficult to date. They were largely discovered in brickearth and gravel pits by John Allen Brown during the 1880s and 90s, and by R. Garraway Rice from 1905 to 1929 (Brown, 1887, 1895; Collins, 1978). In the modern literature, attribution of the artefacts to their stratigraphic context has never been very



**Figure 1.** The Middle Thames between Slough and central London showing key Levallois sites and the mapping of the Thames river gravels.

Site	Context	Dating (OIS)	in situ/primary/ secondary context	Levallois artefacts	Recent reference
Purfleet (Botany Pit), Essex	upper gravel	early 8	secondary	*	Bridgland <i>et al.</i> 1995
Ebbsfleet Channel (Baker's Hole), Kent	coombe rock/ basal gravel	late 8	primary	***	Wenban-Smith 1995
West Thurrock, Lion Pit tramway, Essex	basal gravel	late 8	primary	**	Bridgland 1994, 237-51
Crayford, London	base of brickearth	late 8/early 7	in situ	***	Bridgland 1994, 249-50
Pontnewydd, Conwy	Lower Breccia	mid 7	primary-secondary	**	Aldhouse-Green 1995
Maidenhall/Stoke Tunnel, Suffolk	'Bone Bed'	7	primary	*	Wymer 1985, 234
Brundon, Suffolk	base stratum 3	7	primary + secondary	**	Wymer 1985, 200
Selsey, West Sussex	Channel	7	primary	*	Sutcliffe 1995
Aveley, Essex	interglacial silty clays	late 7	primary	*	White, <i>M. pers. comm.</i>
Bapchild, Kent	combe deposit	?	secondary	**	Dines 1928
New Hythe Lane, Kent		?		**	Roe 1968, 167

**Table 1.** All datable and other major Levallois sites. \*\*\* = major occurrence of Levallois artefacts; \*\* = moderate numbers of Levallois artefacts; \* low numbers of Levallois artefacts

clear. For example, Collins (1978, 46) suggests that at Yiewsley (West Drayton) the Levallois artefacts (based on depth and condition) are from in or beneath solifluction gravels. Roe (1981, 216) suggests that those from West Drayton come from '... within the brickearth or perhaps from an old land surface below it but on top of the gravel'. In the most recent account, Wymer (1999, 80-81) suggests that Levallois artefacts come from in or under the brickearth, but that some must have come from underlying fluvial gravel because of their rolled condition. A preliminary re-examination, by the present authors, of Levallois material from this area does not support this last conclusion. Indeed, there is a distinct difference in condition between the rolled handaxe assemblages that do come from within the fluvial gravel, and the much fresher appearance of the Levallois artefacts. The fluvial gravel is mainly attributed to the Lynch Hill Gravel, though sometimes also to lower terrace units (Taplow and Kempton Park Gravels). The situation seems to have been summed up by Roe (1981, 216), who wrote of the West Drayton sites that '...there is nothing that can be done with the old collections except to generalise, and treat them as a loose single group'.

Work on the brickearth (sometimes termed Langley Silt Complex) has been undertaken by Gibbard *et al.* (1987), who concluded that it was a '...polygenetic unit formed during at least two periods...'. The OSL dates they obtained suggested that where it overlay Taplow and Kempton Park terrace gravels it was late Devensian or Flandrian in age, but where it overlay Lynch Hill terrace gravels its age was less clear. At Iver a Late Devensian age was suggested (13,000 BP), whereas at Yiewsley two dates of greater than 70,000 and 150,000 BP were obtained. At Prospect Park, near Heathrow Airport, the Langley Silt Complex that overlies Taplow Gravel has again been dated to the Last Glaciation (Rose *et al.*, 2000).

This note re-evaluates the problem from two angles: (1) the original published descriptions, where given, of the exact context of Levallois material in this area; and (2) the horizontal distribution of Levallois sites and find-spots in relation to the terrace stratigraphy.

## Context

Although recent summaries, discussed above, suggest that Levallois artefacts have been located in, on and above the terrace gravels, the original published descriptions suggest a more specific context for this material. At Creffield Road (747 Levallois pieces), Brown (1887, 55-61) describes the artefacts as coming from 6 feet down beneath the brickearth, immediately above 'high terrace gravel' (Lynch Hill). Two lower horizons in this gravel are often referred to, but Brown only describes ten artefacts as coming from these units. A preliminary look at the collection has not revealed Levallois artefacts from within the

gravel. So far, only one rolled handaxe has been identified, which from its label is clearly from within the gravel.

A further description is given for the West Drayton area by Brown (1895). When describing the pits to the north of the canal (Eastwood's, Sabey's, Pipkin's and Maynard's Pits), the context from which the Levallois artefacts come is also quite clear. After describing the handaxes from the stratified gravels (Lynch Hill), Brown notes:

'A number of Palaeolithic implements of later age, consisting of long, sharp spear-heads, knives, etc., wrought into shape by secondary chipping, have been discovered nearer the surface than the ordinary implements formed from nodules. They are generally found at depths varying from 5 to 10 feet, and beneath the unstratified deposit. They are often nearly 6 inches in length, and are as sharp and unabraded as if they were made yesterday; they vary in colour externally and are lustrous.

As mentioned elsewhere, they probably belong to the same age as those found at the late Palaeolithic floor at Acton, which they greatly resemble, and may be classed with the long, flake-formed implements of the oldest cave in the Dordogne, that of Le Moustier. They are found beneath the unstratified deposit and the brick-earths, and the different depths at which they are discovered may be accounted for in the varying thickness of the unstratified or ice-borne deposit, and its absence in some sections, or the stratified beds may not have suffered so much erosion.' (Brown 1895, 163-4).

This description again suggests that they are located on the surface of the Lynch Hill gravel, beneath the unstratified (periglacial) gravel and the brickearth.

Stratigraphic details of 'Levallois' material are also provided by Lacaille and Oakley (1936) in their description of the pits at Iver. This material has been claimed to come from the full sequence of deposits, from fluvial gravel at the base, to solifluction gravel, red brickearth and grey brickearth above. Seventeen Levallois artefacts are listed by Roe (1968), and those in the British Museum have been recently re-examined. However, in our view, they do not seem to be Levallois. Indeed, some of the blades from the grey brickearth are likely to be Upper Palaeolithic.

Other sites that seem to have contextual information come from around Langley (Figure 1). Roe (1968, 32) lists two Levallois flakes from Langley Marsh. Wymer (1968, 238) records these same flakes as being recovered from brickearth overlying Taplow Gravel and held in the Sturge Collection at the British Museum. The only artefacts from Langley are in the Sturge Collection (originally collected by Brown) and this does indeed include two Levallois flakes. However, Brown (1895, 168-70) is quite explicit about their location, which is from the top of stratified gravel, and beneath unstratified gravel in the

Great Western Pit, about a mile east of Langley Station. The stratified gravel here is clearly mapped as Lynch Hill, not Taplow.

At Slough *The English Rivers Palaeolithic Survey* (TERPS 1996, 71) describes a Levallois core (with 13 other artefacts) from a canal cutting going through brickearth on Taplow Gravel. Roe (1968, 32) describes these same 14 pieces as coming from Langley (Marish). The canal cutting runs along the north side of the Great Western Pit (see above) and passes westwards through Langley and then Slough. The artefacts were collected by Worthington Smith between 1880-1882 from a stretch of canal that passes through both Lynch Hill and Taplow Gravels. Although the exact provenance is uncertain, what is clear from re-examination is that all 14 artefacts are rolled and do not include a Levallois core.

At Home Farm, Harmondsworth (Figure 1), TERPS (1996, 74) also lists two Levallois flakes from brickearth also above Taplow Gravel. These are probably two white patinated flakes, which were distinct from the later prehistoric flintwork from the site, but did not stand out as being Levallois (Jon Cotton, *pers. comm.*). The flakes have not been viewed by the authors.

It seems, therefore, that where a specific context is known, (Creffield Road, West Drayton and Langley, Great Western Pit) the Levallois artefacts come from the surface of the Lynch Hill Gravel, which probably accounts for 80% of such artefacts found in west London. The remaining 20% of Levallois material from other sites have little detail about context.

### Mapping of Levallois archaeology in west London

The mapping of sites in relation to the underlying terrace stratigraphy also provides strong clues to the dating of Levallois material, the information for which has been provided by TERPS (1996). The survey has therefore been used to examine more carefully any potential relationships between the archaeological and geological records in the west London area, specifically between Slough in the west and Acton in the east (Table 2).

	Sites and Find-spots	Levallois Artefacts
Base of brickearth above Lynch Hill Gravel	5	902
Brickearth or Lynch Hill Gravel	16	199
Brickearth above Taplow Gravel (Home Farm)	1 ?	2 ?
Kempton Park Gravel	1	1

**Table 2.** Numbers of sites, find-spots and Levallois artefacts found in the Middle Thames terraces between Slough and Acton.

This mapping indicates, even where a specific context is not known, that 99.9% of Levallois artefacts come from areas mapped as Lynch Hill Gravel. Although seven artefacts were noted in TERPS as coming from areas mapped as Taplow Gravel, these have all been examined and have either been misidentified as Levallois (e.g. Langley canal cutting), or in fact do come from areas of Lynch Hill Gravel (e.g. Langley Marish). One artefact, whose find-spot is peripheral to the area considered, and does come from a different terrace unit, is a very rolled Levallois flake from Mortlake found in Kempton Park Gravel (Sturge Collection, British Museum). The piece is clearly derived, and may come from a higher terrace.

### **Dating the west London sites**

The implication of this pattern is that there is a remarkable relationship between the occurrence of Levallois archaeology and distribution of Lynch Hill Gravel. There are therefore two factors that are critical for the dating of Levallois artefacts from west London: (1) the position, where known, of these artefacts on the surface of Lynch Hill Gravel; and (2) the absence (with one exception) of Levallois artefacts from above, on the surface of, or within any other terrace formation. This strongly suggests that the artefacts date to a period after the aggradation of the Lynch Hill Gravel, but before the aggradation of the Taplow Gravel, this intervening period of time being widely attributed to late OIS 8 or early OIS 7 (Bridgland, 1994). This accords with dates for other Levallois sites (Table 1) which seem to be attributable to OIS 8 and 7. The fresh condition of the artefacts, might further suggest that the artefacts were quickly covered.

### **Conclusion**

The reinterpretation of the dating of the west London sites has implications for recent models about the Middle Palaeolithic occupation of Britain. These models suggest that population declined rapidly in OIS 7, and that there was an absence from OIS 6 to perhaps the end of OIS 4 (Currant and Jacobi, 2001; Ashton and Lewis, 2002; Ashton, in press). In the absence of firm dating, the west London sites formed a significant quantity of Levallois material that could not contribute to these models. The suggested dating of these sites adds strength to the contention that the majority of Levallois material from Britain dates from OIS 8, and into early OIS 7, what has been formalised as the British Early Middle Palaeolithic (White and Jacobi, 2002). This does not deny that some British Levallois material may be of mid-Devensian age, as at Bramford Road, Ipswich, Suffolk (Wymer, 1985, 213-6), and this may explain the rogue artefact from the Kempton Park Terrace at Mortlake. It is hoped that future work will examine more closely the context and dating of the sites in west London.

## Acknowledgements

We thank Simon Lewis and Simon Parfitt for commenting on earlier drafts of this paper, Jon Cotton and Lynn Bevan for information on the two flakes from Harmondsworth, and Stephen Crummy for the illustration. This paper is part of the *Ancient Human Occupation of Britain* project, funded by the Leverhulme Trust.

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# HOLOCENE HERPETOFAUNAS FROM SCANIA AND HALLAND, SOUTHERN SWEDEN

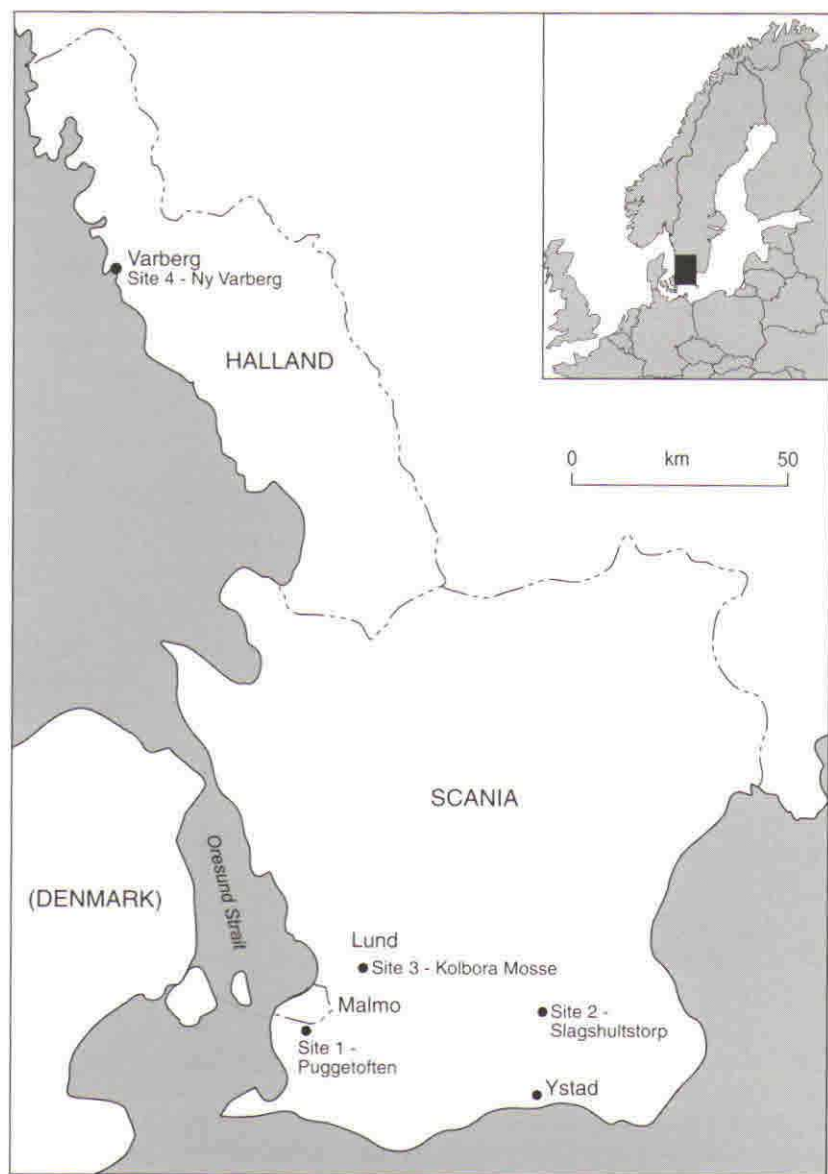
C.P. Gleed-Owen

## Introduction

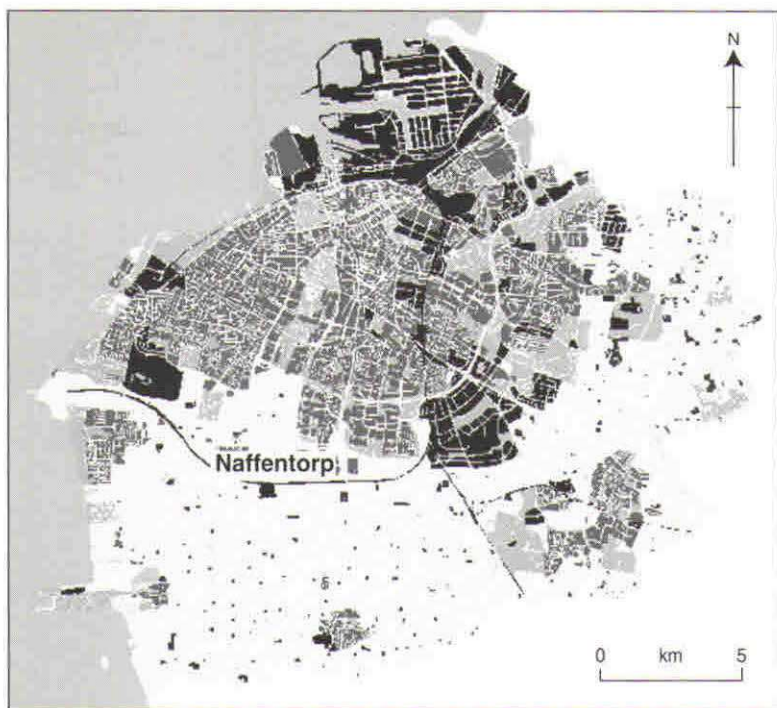
Swedish archaeological and geological excavations produce amphibian and reptile remains with the same regularity as British sites, but the absence of personnel able to identify them has resulted in only a few published studies. Isberg's (1929) account of middle Holocene occurrences of the European pond terrapin *Emys orbicularis* at Swedish sites is well known, mostly because the species is limited much farther south today. Lepiksaar (1967) reported common toad *Bufo bufo*, cf. green toad *Bufo viridis* and agile frog *Rana dalmatina* from the sacrificial bog site of Skedemosse on the Baltic island of Öland. From the same island, the Iron Age and Medieval fortification of Eketorp produced remains of *B. bufo*, *B. viridis*, *R. dalmatina* and moor frog *R. arvalis*. (Boessneck and von den Driesch, 1979). Through recent contact with Swedish archaeozoologists, an opportunity arose to study herpetofaunal assemblages from four sites in Scania and Halland, southern Sweden (Figure 1). A grant received from the QRA, to cover travel and living expenses, enabled a short study visit to Gothenburg and Malmö during late November/early December 2001. Owing to the lack of existing work, some of the identifications arising from this study are first records for Sweden. All of the species are present there today, but most are restricted to Scania and other coastal areas of southern Sweden. Gislén and Kauri (1959) made the first real attempt to map the distribution of the Swedish amphibians and reptiles. Updated maps were presented by Ahlén *et al.* (1995); see also the European atlas (Gasc *et al.*, 1997).

## Site 1 – Naffentorp, Scania (Copenhagen Bridge Project)

The construction of the Öresund Bridge from Malmö to Copenhagen during the late 1990s led to a large programme of rescue archaeology. The collection of bones studied here came from a 12<sup>th</sup> century farmstead at Naffentorp, on the rail link around the southern outskirts of Malmö (Figure 2). A map (Figure 3) dating to around 1700 describes two fields on the farm as *Puggetoften*, which in Old Swedish means 'frog fields' (B.-M. Hägerman, *pers. comm.*). The observation of numerous amphibian bones at this site drew the excavators' attentions, with the result that many were hand-picked (from 61 different contexts) and plotted in three dimensions. Environmental bulk sampling is not widespread in Sweden (L. Jonsson, *pers. comm.*), but one visibly bone-rich feature, interpreted as a probable posthole, was wet-sieved and found to contain over 30,000 anuran



**Figure 1.** The provinces of Scania and Halland in southern Sweden, showing the site locations.



**Figure 2.** The city of Malmö in the province of Scania, showing the Öresund Bridge rail route and the Naffentorp site.

(frog/toad) bones. All of the above material is currently housed at the archaeological laboratory of Malmö Kulturmiljö (the city heritage department), where the vertebrates are being studied by Britt-Marie Hägerman. The species list is as follows: *B. bufo*, *B. viridis*, natterjack toad *Bufo calamita*, *R. arvalis* and common frog *Rana temporaria*. No snakes, lizards or newts were recovered, probably due to the overall lack of bulk sieving.

The remains of 933 juvenile frogs and toads were contained in the posthole fill (context 92) based on a count of radioulnae (lower arm bones) (B.-M. Hägerman, *pers. comm.*). It was clear that the assemblage was composed of whole skeletons, therefore only the ilia, which are typically well-preserved and readily diagnostic elements, were identified. Remarkably, the ilia of newly-metamorphosed anurans show all the salient features used for identification, and with some exceptions the skeleton as a whole resembles a miniature of the adult. The large majority of bones from the posthole belonged to *R. temporaria* (831 individuals), with only 62 individuals of *B. bufo* and 40 *R. arvalis*. All of





The hand-picked ilia from the other features showed a different species composition. *R. temporaria* was found in only 35 out of 61 contexts. The others contained varying quantities of the three European toad species: *B. viridis* (22 contexts), *B. calamita* (12 contexts) and *B. bufo* (18 contexts). The current herpetofauna of Scania includes all of these species, as well as other anurans not found in this study (Gasc *et al.*, 1997). The absence of fire-bellied toad *Bombina bombina*, spadefoot toad *Pelobates fuscus* and tree frog *Hyla arborea* is notable. The combined reconstruction for the Naffentorp species is of lowland meadow and marsh, perhaps with lightly wooded areas, much as the landscape would have appeared in Scania before modern agriculture.

## Site 2 – Slagstorpshult-97, Scania

This site is located 20 km north of Ystad in Röddinge parish. It contains a travertine sequence spanning the Boreal, Atlantic and probably part of the Subboreal periods, but it is difficult to interpret because of reversed radiocarbon dates (Gedda, 2001). C. Kurck investigated snails and seeds from there in the 1920s, and a section cut by Björn Gedda (University of Lund) formed part of a recent molluscan PhD (Gedda, 2001). A continuous sequence of 22 samples from the latter study yielded the herpetofaunal remains studied here. The remains are currently held by Leif Jonsson in the University of Gothenburg's Laboratory of Archaeological Science (ANL), located at Gothenburg Natural History Museum.

The herpetofaunal list comprises at least eight species: great crested newt *Triturus cristatus*, smooth newt *Triturus vulgaris*, fire-bellied toad *Bombina* cf. *bombina*, *B. bufo*, *R. temporaria*, *R. dalmatina*, slow-worm *Anguis fragilis*, and snake cf. *Natrix* sp. All of these species are present in Scania today (Gasc *et al.*, 1997). There seems to be some vertical differentiation in the sequence (Table 1), with toads present in lower samples and newts higher up, almost mutually exclusively. This may reflect seral succession, either within breeding ponds or in the local terrestrial environment, a lowering of the water-table, and/or loss of fish from breeding ponds. Toad tadpoles are unpalatable to fish but newts generally avoid ponds with fish. It is also interesting that *T. vulgaris* appears before *T. cristatus*, as the latter prefers more overgrown water bodies and near-climax deciduous woodland (Beebee and Griffiths, 2000). In Britain, *T. cristatus* is virtually absent from early Holocene sites (and unknown from the Lateglacial), whereas *B. bufo* and *T. vulgaris* are represented throughout (Gleed-Owen, 1998; Gleed-Owen *et al.*, in prep.). Towards the top of the sequence, the frog remains become sparse and the newts disappear, perhaps due to anthropogenic vegetation clearance or a general drying or infilling of ponds. Near the top and bottom of the sequence there are a few reptile bones; both *A. fragilis* and *N. natrix* need unshaded grass and herbage for basking in, including open meadows and woodland edges. Gedda's (2001) molluscan analyses

**Table 1.** The amphibian and reptile species from the Slagstorpshult-97 sampling sequence. Abbreviations: Tc = *T. cristatus*, Tv = *T. vulgaris*, Tsp = *Triturus* sp, Bom = *B. cf. bombina*, Bb = *B. bufo*, Bsp = *Bufo* sp, Rt = *R. temporaria*, Rd = *R. dalmatina*, Rsp = *Rana* sp, Af = *A. fragilis*, Nn = *N. natrix*, Oph = indet. snake. Crosses in parentheses denote an element of uncertainty, e.g. "*R. cf. temporaria*".

### Species

Depth (cm)	Tc	Tv	Tsp	Bom	Bb	Bsp	Rt	Rd	Rsp	Af	Nn	Oph
0							x					
0-5									x		(x)	
5-10									x			
10-15	x								x			
15-20	(x)		x				x					
20-25									x			
25-30									x			
30-35												
35-40	x		x				x	x	x			
40							x		x			
40-45		x					x		x			
45-50							x		x			
50									x			
50-55							x		x			
55-60		x			x	x	x		x			x
60							x		x			
60-65				(x)	x	x	x		x			
65-70						x	x		x			
70-75							(x)		x			
75-80							(x)		x	x		
80-85					x		x		x			x
85-90							(x)		x			

identified a mosaic of shaded and open habitats, but with some enigmatic combinations of terrestrial snails. Without reliable dating control, it is difficult to add further detail to this reconstruction.

The subfossil find of *Bombina* is the first from Sweden. The single sacrum cannot be identified to species, but biogeographically *B. bombina* is the only real possibility. The find may conclude a debate over its native status in Sweden. *B. bombina* became extinct before being artificially reintroduced in recent years (Gollman *et al.*, 1997), but there are claims that its presence was linked to 18<sup>th</sup> century carp introductions anyway (L. Jonsson, *pers. comm.*). This new find from Slagstorpshult, from an early to middle Holocene context, supports a natural origin for *B. bombina* in Scania. The paradigm that isolated anomalous populations must by default be artificial introductions is untenable, as highlighted by a similar scenario in Britain (Gleed-Owen, 2000; Foster *et al.*, in prep.).

### Site 3 – Kolböra Mosse, Scania

This promising site is located near Lund and comprises deposits of mainly Preboreal age (L. Jonsson, *pers. comm.*). The material studied came from a single bulk sample taken from a trial trench excavated on a geology field trip. It contained *B. bufo* and *R. temporaria*, as well as thermophilous cyprinids, a grebe, and freshwater molluscs (L. Jonsson, *pers. comm.*). These finds support a very early Holocene arrival in southern Sweden for *B. bufo*, *R. temporaria* – a fact mirrored at British sites (Gleed-Owen, 1998; Gleed-Owen *et al.*, in prep.). Given that only one sample was analysed, the productivity of the site is unquestionable, and further multidisciplinary work will undoubtedly take place.

### Site 4 – Ny Varberg, Halland

This archaeological site is in an abandoned town, 3 km north of present day Varberg in the province of Halland. Some herpetofaunal remains were recovered from a well, built circa 1590 and filled by 1612, which was enclosed in a stone-paved yard (L. Jonsson, *pers. comm.*). There were several partial skeletons of *B. bufo* and *R. temporaria* in it, plus six vertebrae from one individual of *T. cristatus*. All three species are present in the province today (Gasc *et al.*, 1997). The well was filled with water brought from outside the town (L. Jonsson, *pers. comm.*), perhaps explaining the presence of the unfortunate amphibians, as well as great pond snail *Lymnaea stagnalis*.

### Conclusion

This brief study has revealed the presence of important herpetofaunal assemblages in Swedish collections. The assemblages span a range of Holocene

ages and permit useful palaeoenvironmental and biogeographical insights. This report serves as a preliminary summary of findings from a short study. The QRA-funded visit initiated interdisciplinary contact with Swedish workers, helped 'spread the word', and served as a pump-priming exercise for future collaborations. A lecture to staff and students at Gothenburg Natural History Museum was warmly received, and this work should encourage archaeologists and geologists to consider herpetofaunal remains as worthy of study.

### Acknowledgments

A Quaternary Research Fund grant from the Quaternary Research Association made this work possible. I am also especially grateful to my hosts Leif Jonsson (Gothenburg University) and Britt-Marie Hägerman (Malmö Kulturmiljö) for their kind hospitality and enthusiastic assistance. Leif Jonsson and Trevor Beebe provided useful comments as referees.

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# REPORTS

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## THE SEVENTH ANNUAL QRA POSTGRADUATE SYMPOSIUM

11–13<sup>th</sup> September 2002, Universiteit van Amsterdam

Postgraduates from across northern Europe assembled at the Universiteit van Amsterdam for three days of discussion, debate and fine Dutch hospitality.

### Day 1

Professor Verstraten, Director of the Centre for Geo-Ecological Research, welcomed participants to the Symposium. Klaasjan Raat chaired the first session on Palaeoclimate and Palaeoecology and **Jeroen Schokker** (Utrecht, Netherlands) was first to the podium with a very well illustrated report on his research into the Weichsalian aeolian stratigraphy of the Roer Valley Graben of the SE Netherlands. His good use of OSL dating and pollen analysis argued strongly for the sediment preservation and environmental stabilisation of these deposits. Next **Richard Payne** (London QM, UK) gave an excellent and entertaining introduction to the climatic impact of volcanism, using a multi-proxy analysis of Alaskan peat-bog deposits. Given the current concerns about climate change the importance of this type of research cannot be over-emphasised, and this theme was continued by **Shirley Wynne** (Exeter, UK). Her multi-disciplinary approach to unravelling palaeomoisture records in Assynt, NW Scotland, has resulted in strong correlation between sites, indicating that the climatic changes detected are operating at a regional scale. Of equal interest were her excellent overviews of the two little-known methods of peat humification and speleothem analyses. Taking us to the other side of the globe, **Mirjam Vriend** (VU Amsterdam, Netherlands) outlined her discoveries in the Chinese Loess Plateau. Evidence for strong monsoonal variability over the past 90 ka in the region was enhanced by superb satellite imagery, and a particularly lucid explanation into the mechanics of oxygen and carbon isotope analysis.

**Zoë Hazell** (Plymouth, UK) illustrated how a wide range of techniques normally associated with boreal environments can be put to use in the peatlands of New Zealand, in order to deduce Holocene climate change. **Simon Six** (Leuven, Belgium) gave a fascinating account of his attempts to reconstruct the ecology and economy of the ancient city of Sagalassos in Turkey. Of particular interest was his use of archaeological, geomorphological and palaeoecological

theory to unravel the mystery of this lost civilisation. Moving into colder climes, **Megan Ellershaw** (London QM, UK) provided more strong evidence for the value of multi-proxy analyses in palaeoclimate reconstruction in the North Atlantic. Results show major correlation between peat bog palaeohydrology over time, at sites as far apart as Greenland and Shetland. Unusual in its equatorial location, the research of **Phil Metcalfe** (Swansea, UK) in the remote rainforests of Bolivia was both exciting and original. Evidence from various environmental proxies, including the relatively little known technique of grass-cuticle analysis, was shown to have important implications for a thorough understanding of Amazonian biodiversity and regional ecology. In the last talk of the day, **Mark Tarplee** (London QM, UK) introduced his forthcoming research on glacial erratic trains in western Ireland. His analysis of geochemical anomalies in the Tynagh Mineralisation of Co. Galway should produce interesting findings for future mineral exploration.

That afternoon, Matt Jones led us through the poster viewing session. A tremendous range of subjects was on display, from the Late Glacial palaeoclimatology of northernmost Norway to the Holocene history of an Antarctic ice-shelf. A strong glacial geomorphology contingent also made its presence felt with contributions from sites in Belgium, Wales, Nepal, New Zealand and Antarctica. This international flavour was also reflected in the varied nationality of the delegates, with six countries being represented at the symposium.

The last event of the opening day was the keynote lecture from **Professor Dick Kroon** (VU Amsterdam, Netherlands), who gave a fascinating and highly informative talk on Late Pleistocene climate variability. Concentrating on the isotope stage transition 12/11, he presented evidence for disruption of the Agulhas Current from planktonic foraminiferal variability in contrasting water masses off the coast of SE Africa.

## Day 2

The second day began with a series of three talks on fluvial and coastal systems, and three talks concerning archaeology and the Holocene, chaired by Maartje van Meeteren. **Erin McClymont** (Durham, UK) opened the session with an absorbing account for her use of biomarker proxy records in reaching a better understanding of the role of ocean circulation and the carbon cycle in glacial/interglacial forcing. Significantly, results from ODP cores from both the North and South Atlantic show that changes in circulation and biological pump strength actually predate published records of climate change. Moving inland, **Patrick Bogaart** (VU Amsterdam, Netherlands) changed the tack of the previous discussions to a modelling-based approach. His work on the responses of the River Maas to rapid climate change provided an example of how

modelling can dramatically increase our understanding of physical processes. **Graham Wilson** (Liverpool JM, UK) outlined the use of carbon isotopes in his study of Holocene coastal evolution around the Mersey Estuary in NW England. The technique hinges on a favourable comparison with results from more traditional sea-level proxies, such as diatom analysis, and its success may provide the opportunity for more robust reconstructions of coastal evolution. **Margaret Nicholls** (Swansea, UK) brought the series into the twentieth century, with a review of her study of plant succession on a Norwegian glacier foreland over the past thirty years. By combining temporal and spatial approaches to the problem, Margaret showed how climate change has affected the local botany. **Nora Bermingham** (Hull, UK) delivered a fine introduction to an interesting archaeological problem. A Bronze-Age wooden walkway discovered on an Irish raised bog leads to multi-proxy palaeohydrological analyses, with the intention of detecting whether the walkway was built for crossing the bog, or whether the increase in wetness drove out the people who constructed it. **Rhiannon Stevens** (Oxford, UK) gave an interesting account of how carbon and nitrogen isotopes in bone collagen can reflect various environmental parameters of the period when the organism in question was alive.

The next session was chaired by Boris Jansen. Unusual in its purely Holocene scope, **Catherine Jessen's** (Lund, Sweden) discussion on the reflection of rapid, regional climate change in the atmospheric carbon-dioxide record dispelled any preconceptions that Holocene climate was stable. Besides the regular ice-core analysis, evidence was also garnered from the stomatal frequency of sub-fossil leaves. **Fraser Green** (Aberdeen, UK) summarised the current understanding of the Scottish Mesolithic, before reviewing evidence of human/forest interaction from pollen and charcoal studies on the Isle of Skye. Sustained peaks in the charcoal record corroborate existing evidence for Mesolithic settlement in the area. Keeping with the Mesolithic theme, **Catherine Chisham** (Reading, UK) related fresh evidence for earlier environmental manipulation than had previously been thought. By moving the usual upland spotlight to lowland southern England, she showed how artefactual and environmental evidence supports claims that humans were influencing the British vegetation as early as the lateglacial. **Stuart Wilson** (Glasgow, UK) discussed the application of some increasingly technological methods to the mapping of glacial erosional and depositional features. Strikingly detailed images of hummocky moraine patterns in the western Scottish Highlands proved excellent testament to the value of GPS, GIS and digital photogrammetry in geomorphological surveying. **Alar Rosentau** (Tartu, Estonia) presented an excellent overview of how the shorelines of the Baltic Ice Lake of the lateglacial can be simulated using both modelling and field information. Ancient shoreline altitudes, neotectonic uplift data, a digital elevation model (DEM) and stratigraphical evidence combine to produce palaeogeographical maps of the shoreline within Estonia.

Following lunch, Klaasjan Raat chaired the next session. This began with **Matt Jones** (Plymouth, UK) explaining how climate-change records can be better quantified by calibration between radiometric dating methods and natural annual indicators, such as tree rings and varves. Examples from his research on laminated lake deposits from Turkey illustrated the approach exceedingly well. **Carl Königel** (UvA Amsterdam, Netherlands) brought a unique insight into the role of pedogenesis in ecological evolution with his account on the use of modelling in predicting landscape dynamics between the pedosphere, biosphere and lithosphere.

The last two presentations of the day concerned glaciers and glaciation of the Quaternary. **Stephen Davison** (Edinburgh, UK) gave a well-illustrated account into the development of glacial deposits off the continental margin west of the Shetland Isles. A detailed stratigraphy of these deposits can now be described using 3D imagery, seismic profiles and boreholes, displaying the behaviour of the Late Devensian ice sheet in this submarine setting. **Mark Lloyd Davies** (UvA Amsterdam, Netherlands) questioned conventional thinking regarding the nature of cold-based ice masses, with a very convincing argument for cold-based ice deformation, deposition and erosion in Antarctica. The marked stability of the local weather systems was cited as a probable reason for the preservation of loose tillites associated with the local cold-based ice masses.

In the second keynote lecture of the conference, **Professor Peter Burrough** (Utrecht, Netherlands) delivered an exceptionally stimulating talk on the rising importance of quantitative analysis in geomorphology. Employing a breathtaking selection of images and a wide variety of geomathematical problems, he brought to light how the theoretical machine drives the need for better understanding and implementation of numerical modelling in physical geography research. Professor Burrough managed to elucidate a number of thorny issues, and although many of us would perhaps like to avoid such numerical entanglements, the message was clear that we could no longer afford to ignore the evident value of pattern and process modelling in our research. Day two drew to a close with a delightful conference dinner.

### Day 3

With Marcel Bakker as chair, and continuing the glacial theme from the previous day, **Paul Sirota** (Otago, New Zealand) opened with a detailed account concerning the varied mechanical strength of Antarctic glacier basal ice, in terms of the degree of solute and debris enrichment. Laboratory tests indicate that the shear strength of the basal ice is governed to a large extent by the solute and debris content. **Jamie Smith** (Swansea, UK) reviewed the evidence for assessing glacier behaviour through time by using grain-size analysis of proglacial lakes in Norway. Statistical analysis of this data indicates

a strong correlation between sedimentation rates of specific grain sizes and the catchment characteristics. Finally, **James Etienne** (Aberystwyth, UK) delivered an entertaining tour through the glacial deposits of Cardigan Bay in Wales. Deformation structures within laminated clays were highlighted as having significant paleoenvironmental implications about the nature of Irish Sea glaciation.

After tying up the last of the conference business, the delegates were treated to a splendid fieldtrip around Noord Holland, courtesy of Marcel Bakker. The complex interaction of man and environment that is central to the Dutch landscape was amply illustrated by visits to peat-bog coring sites, polders, 17<sup>th</sup> century windmills and vast sea dykes. The late summer sunshine even allowed the more adventurous among us to take a quick dip in the North Sea.

Many thanks must go to the organisers of the symposium – Mark Lloyd Davies, Boris Jansen, Klaasjan Raat, Maartje van Meeteren, Ulrich Leopold and Marcel Bakker – for their tireless preparation and superior hospitality. The international aspect of the conference is also to be commended, and it is hoped that this will become a feature of the event in the future. Congratulations also to **Gunther Ghysels** (Ghent, Belgium) and **Fraser Green** (Aberdeen, UK) for winning best poster and best oral presentation respectively. Unanimous judgement declared Queen Mary, University of London, to be next year's hosts and we all look forward immensely to a repeat of this year's undoubted success.

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# THE QUATERNARY OF SOUTH WEST IRELAND

QRA Short Field Meeting, 20<sup>th</sup> – 23<sup>rd</sup> September 2002

This meeting was based at Killarney and covered a pleasant diversity of sites ranging in age from Ipswichian (and possibly an earlier interglacial) to the Late Holocene, and in locality from the Mizen Peninsula to southern County Clare.

## Day 1

Day 1 focussed on the Macgillicuddy's Reeks. After a gentle ramble up the Gaddagh Valley **Stephan Harrison** (University of Oxford) introduced the Hag's Teeth Moraine marking the last glacial maximum (Glenavy Advance). **Dave Passmore** (University of Newcastle) then detailed the history of Holocene alluvial terraces and associated flood deposits. Palynological data explained by **Tim Mighall** (University of Coventry) revealed deforestation as a result of climate change and human intervention. Subsequent terrace development was controlled after a considerable lag by a limited number of late Holocene high-energy flood events, some illustrated in the Hag's Glen Alluvial Fan. Parallels were drawn with previous research in the British Isles and by **Colin Lewis** (Rhodes University) with South Africa.

After a precipitous climb **Stephan Harrison** pointed out the Bone rock glaciers (or were they pro-talus lobes?) The day concluded with illustrations of ice dynamics, trimlines and nunataks in the Gap of Dunloe, led by **Alaric Rae** (Coventry University).

## Day 2

Day 2 had more of an archaeological flavour as the dynamic **Billy O'Brien** (University of Galway) conducted the group on a tour around some of the 32 recorded Bronze Age copper mines on the south east flanks of Mount Gabriel (407 m) on the Mizen Peninsula. The excellent weather that dogged the whole trip afforded wonderful views to the south over the Sherkin Island archipelago and Roaringwater Bay. **Tim Mighall** and **Scott Timpany** (University of Reading) demonstrated the generally subdued impact of Bronze Age mining on the surrounding vegetation, as revealed by pollen analysis on the mountain-side and valley peats.

The Altar Wedge Tomb, Toormore Bay, was used by **Billy O'Brien** to demonstrate the organization and settlement patterns of these early metallurgical societies. As the day lengthened and the midges massed **Tim Mighall** and **Jon Lageard** (Manchester Metropolitan University) introduced Cadogan's Bog,

where failure of pine trees to re-establish after 4000 BP has been associated with changing nutrient status of the mire.

### Day 3

A short trip to Ross Island on the shores of Lough Leane continued the theme of early copper mining – possibly from the Copper Age. **Billy O'Brien** outlined evidence for tin imports from Cornwall, trade with Wales and continental Europe and the results of a dig that commenced in 1992. The latter revealed all aspects of copper production, including 12,000 stone hammers.

The next stop was at Doyles Quarry to the east of Killarney. Here **Michael Philcox** (Trinity College Dublin) explained the stratigraphic associations in the complex series of gravel terraces and drainage channels that document several stages of the retreat and advance of piedmont ice emanating from the Macgillycuddy's Reeks.

After driving north and crossing the Shannon, **Andy Richards** (University of Limerick) introduced the group to Bridges of Ross, a cove in southern County Clare, and its Pleistocene deposits which overlie a wave-cut platform. The stratigraphy included a polleniferous clay-silt unit containing comparatively rare evidence of Irish interstadial flora.

### Day 4

The first site on Day 4 was on the spectacular Dingle Peninsula at Feohanagh. **Andy Richards** showed the group 16-m high cliffs containing sub-glacial deposits from the Midlandian (Devensian) and evidence for two antecedent warm-stage raised-beach deposits.

Archaeological withdrawal symptoms were then assuaged by a visit to the early Christian Gallarus Oratory (c AD 600-700).

Discussions at the Connor Pass involved previous work detailing the glacial history of the Dingle by **Colin Lewis** and more recent research by **Phil Allen** (Coventry University). Travelling to the north the group then visited Lough Doon, a spectacularly fresh and accessible cirque with classic examples of cross-cutting striae and chatter marks.

The final site was another cirque, Mhonain Corrie, where **Colin Lewis** revisited and **Phil Allen** discussed current geomorphological mapping and presented palynological data that showed analogous results to the Gaddagh Valley on Day 1. This was a fitting point at which to close and **Colin Whiteman** (University of Brighton) thanked the organisers **Stephan Harrison** and **Tim Mighall** for an excellent meeting and also a significant number of postgraduate students for their valuable contributions.



A QRA field guide has been produced to accompany this meeting (Harrison and Mighall, 2002).

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# INQUA COMMISSION ON SEA-LEVEL CHANGES AND COASTAL EVOLUTION, SUB-COMMISSION WESTERN EUROPE

## Field Meeting

September 22-27<sup>th</sup> 2002 in Greifswald and Mecklenburg – West  
Pomerania

This meeting was overdue. The last time an INQUA Commission visited this region of East Germany was in 1967. Despite the fact that East German scientists were long-standing members of the Sub-commission of Western Europe, political divisions prevented any field meeting in the former GDR. Now, ten years on from political reunification, the Sub-commission was welcomed to the Greifswald and Mecklenburg, West Pomerania region, for a fieldtrip with the theme of "Holocene Evolution of the South-Western Baltic Coast – Geological, Archaeological and Palaeo-environmental aspects", organised by Dr Reinhard Lampe and colleagues.

This excellent meeting, which was attended by over 40 scientists from nine countries, convened in Greifswald on the evening of September 22<sup>nd</sup> and spent the following day enjoying a wide ranging set of 15 papers and posters detailing recent and current work by Sub-commission members. Papers addressed issues of ice-sheet history in Greenland (Long and Roberts) and Scotland (Dawson and Smith; Smith *et al.*), late Holocene stratigraphic infill sequences from the palaeochannels of the Belgian coastal plain (Baeteman *et al.*), the Holocene history of the coastal dunes of the Aquitaine coast of SW France (Tastet *et al.*), late Holocene sea-level changes in the Maldives (Morner), the geoarchaeology of the Netherlands (Vos), and recent developments in North Sea and Baltic sea-level curves (Behre, Linke). Papers in the afternoon concerned on the Baltic region and addressed sea-level changes in Southern Finland (Eronen and Mietenen), the Littorina Sea sediments in SE Sweden (Berglund *et al.*), early Holocene water-level fluctuations in the western Baltic (Lemke *et al.*) and Danish molluscan faunas (Petersen). The final session of the day was a warm-up for the field trip, with papers detailing Holocene geological and archaeological sites of the Puck Lagoon (Uscinowicz *et al.*), the submerged archaeology of the Wismar Bay area (Lübke), and a final over-view of the post-glacial water-level history of the south Baltic coast (Lampe).

## Tuesday 24<sup>th</sup> September

The fieldtrip began with a drive along tree-lined roads across the gently undulating landscape of the southern Baltic coastal plain onto Rügen Island.

The island is, in fact, an archipelago comprising a dozen small and large islands which are connected by barrier spits. The day began with a review of the early medieval trading site of Ralswick (Th. Terberger), where footways and quays provided well-dated evidence for sea-level change during the last thousand years or so. From here we moved onto a large section dug through a late Mesolithic settlement site at Ralswick-Augustenhof and Litezow-Buddelin. The 2 m deep section demonstrated several major changes in palaeoenvironment with organic deposits rich in cultural remains. A 10 m long core collected from the nearby Kleiner Jasmunder Bodden provided wonderful evidence for the influx of the Littorina Sea into the area during the early Holocene (W. Janke and R. Lampe). At the last stop before lunch, W. Schumacher presented a shoreline displacement curve for Rügen Island. This caused considerable debate, with attention focussed on the evidence for a 6-8 m "regression" dated to c. 5000 BP, possibly caused by neotectonic movements. This aspect of the Holocene relative sea-level history of the region re-appeared frequently during the next few days with evidence both in support of and against this hypothesis. In the afternoon we examined the spectacular coastal cliffs at Jasmund, before visiting the gravel barrier spit at Schmale Heide, which protects the Kleiner Jasmunder Bodden and Schmachter See. R. Lampe, W. Janke and G. Hoffman described a combination of borehole and ground penetrating radar data which were used to reconstruct the late Holocene evolution of this large gravel barrier.

### **Wednesday 25<sup>th</sup> September**

Our second day was spent on the Usedom Island in the eastern part of the Federal Republic. We began with a review of recent peat stratigraphic investigations focussed on the river valleys in Mecklenburg, West Pomerania (W. Janke and H. Joosten). These valleys contain peatlands largely fed by spring water, which form extensive valley floor percolation mires as well as fluvial transgression mires near to the central river zones. One well-dated sequence from the Recknitz valley demonstrated two "transgression mires" which were cautiously correlated with the Litorina I transgression (dated to 6150-5000 <sup>14</sup>C BP) and the Litorina II transgression (dated to c. 4000 <sup>14</sup>C BP).

From here we drove to cliffs from which we enjoyed fine views across the Szczecin Lagoon, which has been the subject of recent study by Polish (K. Osadczuk) and German (G. Hoffman, W. Janke, R. Lampe) scientists. Cores from the lagoon show a late glacial sequence of fluvial and limnic deposits which pass upwards into Holocene swampy and limnic deposits. These were inundated sometime after 6200 <sup>14</sup>C BP by marine conditions associated with the Littorina I transgression. These Littorina sediments were replaced, after c. 4800 <sup>14</sup>C BP, by extensive fresh/brackish deposits which accumulated as the lagoon became isolated from the Baltic by the development of the Swina barrier

spit across the Odra river mouth. This barrier is anchored on two moraines located on either side of the German / Polish border and is a spectacular example of sand spit development over the last 5000 years or so. Discussion focussed on the processes that initiated barrier development, which was broadly coincident with the end of the rapid rise in relative sea-level associated with the Littorina 1 transgression.

Lunch was taken astride the wonderful collection of erratic boulders held in an erratic museum at Forstamt. G. Hoffman gave us an informed guide of the rocks, dousing each rock with water to highlight their striations, minerals, and structures. So important are rocks in this area that it is illegal to move boulders over 1 m<sup>3</sup>. There is even a rock-fishing industry based on the recovery of erratics from the sea floor. The afternoon was spent examining the outer coast of Uwsedom Island. This began with a review (W. Schumacher) of coastal protection works which are designed to protect the 200 m wide stretch of glaciogenic sediments which separate the Baltic from the inland lagoon (the *Achterwasser*). These defences comprise offshore bars and colossal beach feeding, represent the latest in what is already a long history of coastal management, which can be traced back in to the 19<sup>th</sup> century. The sand released by these coasts has, in part at least, supplied the extensive sand dunes which comprise the Peenemunde-Zinnowitx coastal lowland. This lowland, which extends over 52 km<sup>2</sup>, lies only a metre or so above sea level and is made almost entirely of Holocene sands of various depositional origin. Later that afternoon we examined the stratigraphy of two pits dug into the sand dunes in the Bannemin area, which each demonstrated the general stratigraphic sequence of the complex (G. Hoffmann, W. Janke, R. Lampe). This included the identification of different coloured sand deposits. These colour differences are used locally to identify "brown", "yellow", "white" and "white 1" deposits, with each deposit ascribed a particular age. This type of chronostratigraphic correlation by colour is widely accepted, but the need for some independent corroboration of these age estimates was clear.

The last stop of the day was on the wooded shores of the Greifswalder Bodden, an extensive shallow coastal basin in the bounded to the north by Rügen Island and the south by the Greifswald coast of Germany. Seismic and stratigraphic data from the basin reveal a now familiar sequence, with glacial till overlain by glaciofluvial sands, lacustrine silts and organic deposits, "transgressional peats" associated with the Litorina transgression, and marine brackish muds and sands which extent to present surface (H. Bauerhorst).

#### **Thursday 26<sup>th</sup> September**

This day was centred on the Fischalnd-Darss-Zingst peninsula, which lies to the northwest of Greifswald. We began on the outskirts of Greifswald itself, where

R. Lampe explained the history of salt meadow evolution during the last few thousand years. Having almost no tide, this region lacks the saltmarshes which those from the North Sea and Atlantic coasts are familiar with. However, there are subtle changes in environment associated with small (decimetre) changes in sea level, which record changes in salinity, wind and wave energy, organic and minerogenic accumulation. Yet another beautiful core was presented, with attention at this stop focussed on highly humified "black horizons" within the organic sediments. Increases in pollen concentration, greater humification, and some evidence for a break in sedimentation based on radiocarbon ages, together support the hypothesis that these horizons record episodes of peat drying, caused by sea-level changes or, perhaps, changes in climate and freshwater discharge. The former hypothesis is preferred by Lampe, with dates on these horizons used to identify small scale "regressive" horizons caused by falls in relative sea-level. The most recent regressive horizon was associated with a proposed fall in RSL during the Little Ice Age.

From here we drove on to the Fischland-Darss-Zingst peninsula, which forms the westernmost part of the West Pomeranian Bodden coast. The area is formed of Late Pleistocene glacial and Holocene sediments, open to the Baltic in the north and with *Phragmites* reedswamps fringing inland lagoons to the south. R. Lampe introduced the geomorphological evolution of the area, before W. Schumacher detailed the mid and late Holocene evolution of the Daars Peninsula. This is yet another large sand cusate foreland which formed following the initial rapid phase of sea-level rise associated with the Littorina transgression. Leaving the coach on the outskirts of the National Park, we were transported in horse-drawn carts across the sandy beach ridges which comprise the foreland, to reach the Daars lighthouse from whose airy heights we enjoyed wide ranging views across the area.

The afternoon was spent dodging the occasional violent rain shower, examining the high cliff sediments exposed on the cliff of Fischland. The cliff reveals five stratigraphic units; a lower and an upper till, basin sands, "Heidesand" and an uppermost dune sand. Most attention focussed on the "Heidesand", a sand deposit which accumulated in open (fresh) water conditions between the Allerød and the early Holocene. This cliff gave fine views across the wind-swept Baltic and the Darss sill. W. Lemke gave an overview of the role of this sill in the history of the Ancyclus Lake drainage, referring to the work of others, such as Kolp and Bjorck, who have suggested that the Daars sill was a threshold across which catastrophic water drainage occurred between the German Daars peninsula and the Danish island of Flaster. This earlier work had suggested that the river which drained across this sill, known as the Dana River, persisted for c. 1000 years, and discharged water from the Ancyclus into the Kattegat. W. Lemke presented new seismic and vibracore data which suggested that the Daars Sill was not, in fact, the proposed route for the drainage of the Ancyclus.

The day ended with a consideration of the coastal defences of the Fischland-Darss-Zingst peninsula, and a further consideration of salt meadow cores from the Ribnitzer Wiesen.

The evening was spent in the large, rambling, Hotel An de See at Neuhaus. Before an excellent conference dinner, a business meeting was held which considered the future work of the Sub-Commission given the proposed changes in INQUA structure after Reno 2003, plans for future fieldtrips by the Sub-Commission, and proposals for two publications arising from the meeting.

The final day of the meeting began with a review of the submarine Stone Age settlements of the Wismar Bay area, where H. Lübke described extensive spreads of Mesolithic archaeology which is associated with well-defined palaeoshoreline evidence in water depths of up to c. 10 m below present. There followed an examination of the heavily glacio-tectonised diamicts of the western cliff on Poal Island lead by U. Müller, and some final thoughts on the development of the Rustwerder spit and evidence for storm floods in the southern Baltic Sea by Walter Schumacher, which brought the meeting to a close.

This was an excellent meeting and the organising team, led by Reinhard Lampe, are to be congratulated on putting together a fascinating conference and fieldtrip. The logistics were faultless, with sections dug, cleaned (and in one case illuminated) ahead of our arrival, and regular sandwich and coffee stops which allowed plenty of time for informal discussion. Much of the detail of the fieldtrip is presented in a comprehensive field guide (Lampe 2002) which presents, for the first time in English, much of the extensive work which has been undertaken in this region during the last decade. There was a real vibrancy to the research presented here, and the infectious enthusiasm of all the participants helped make this a trip which will be remembered for a long time.

## Reference

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## THE ANCIENT HUMAN OCCUPATION OF BRITAIN (AHOB) PROJECT

The Ancient Human Occupation of Britain research project, a five-year programme funded by the Leverhulme Trust for just over £1.2 million, began in October 2001, and is investigating the timing and nature of human occupation of the British Isles during the Quaternary. The project brings together a range of specialists, including archaeologists, palaeontologists, geomorphologists, stratigraphers, sedimentologists and isotope analysts from British universities and national museums.

The central purpose of the programme is to provide a detailed settlement history of Britain over at least a 500,000-year period, revealing aspects of the technology and behaviour of its Pleistocene inhabitants and exploring how and why these changed over time, reconstructing the environments in which they lived and the resources that these provided, and documenting the animals that shared their landscape. By taking this broad sweep in time within a single sub-region of Europe, it is hoped to identify patterns of human social organisation, behaviour, technology, economies, habitat preferences and landscape use, against the backdrop of frequent ice-advance, sea-level change and the effects of recurrent isolation from mainland Europe.

The aims of the project will be achieved through small-scale fieldwork projects that focus on high-resolution sampling for fauna, flora, environmental information and dating that can be integrated with ongoing documentation and research on existing archaeological and faunal collections. This multidisciplinary approach will use the Oxygen Isotope Stages (OIS) and substages as the yardsticks against which to correlate the fragmentary terrestrial record. Newly developed mammal-based biostratigraphies covering much of the last 600,000 years are currently being explored for still higher resolution, to build on the Mammal Assemblage-Zones (MAZ) that have been suggested for the last 400,000 years (Curren and Jacobi, 2001; Schreve, 2001). Oxygen-isotope analyses of materials such as mammalian teeth, molluscs and carbonates will be used to help link patterns of climate, environment and faunal change to human presence and absence. Carbon and nitrogen stable isotope analysis of fossil bone and teeth will also provide some insight into changing climates, as well as tell us about the diets of past animals and hominids (Richards *et al.*, 1999, 2000). These analyses will be supplemented by sedimentological analyses and geomorphology, geochronology (AMS radiocarbon age determinations of bone, Mass Spectrometric Uranium-series (U-series), Optically Stimulated Luminescence (OSL), Electron Spin Resonance (ESR) and Amino Acid Racemisation), invertebrate biostratigraphy, taphonomy and palaeoecology. These data will be integrated and assessed using Geographic Information System (GIS) technology.

## Key Research Questions

The project has identified seven principal research topics, each focussing on a major episode of this time period and each with its own set of specific research questions. Together, these will form a coherent chronological framework for understanding the ancient human occupation of Britain. The key research areas are:

1. **700,000 - 500,000 years: The nature and timing of the first occupation of Britain.** New analyses of faunal assemblages, and recent discoveries of stone tools within early Middle Pleistocene sediments have re-opened the debate over the earliest occupation of Britain. This will focus on the problem of the first archaeological occurrences, and the nature of these occurrences within the 'Cromerian Complex'. Collaborative fieldwork has already taken place at sites such as Happisburgh (Norfolk), Pakefield (Suffolk), Norton Subcourse (Norfolk), Warren Hill (Suffolk) and High Lodge (Suffolk).
2. **400,000 years: The Hoxnian Interglacial.** This period contains the richest Palaeolithic record in Britain, and is amongst the best preserved in the world. This presents the possibility of fine-grained reconstructions of human habitat choice, landscape and resource use, and investigation of the still intriguing possibility of different populations and lithic technologies. This will be achieved through the integration of the wealth of existing data, and detailed environmental sampling at critical sites. Collaborative fieldwork has so far involved the sites of Hoxne (Suffolk), Marks Tey (Essex) and West Cliffe (Kent).
3. **300,000 - 180,000 years: The Lower-Middle Palaeolithic transition.** This is a period that has been largely ignored in past research, but seems increasingly to mark the introduction of a suite of new technologies that themselves might be linked to changes in hunting practise, habitat preference, landscape-use, and social organisation. These questions will be addressed, together with the problems of whether these changes are indigenous to Europe, the timing of the changes, and with which human population they are associated. Fieldwork is planned at a number of sites, including Grays (Essex) and Stoke Tunnel (Suffolk).
4. **180,000 - 60,000 years: Middle Palaeolithic population collapse.** Increasing evidence points to a decline and disappearance of human populations during this episode. Research will focus on whether this apparent absence can be explained through differential preservation, or if not, the reasons why humans became extinct in Britain (Ashton and Lewis, 2002). In particular, did the dual factors of climate and the insularity of Britain control occupation at this time? Fieldwork is planned for relevant sites in west London (Ashton *et al.*, in press) and the Gower Caves.



5. **60,000 - 22,000 years: Repopulation at the end of the Middle Palaeolithic, and the transition to the early Upper Palaeolithic.** The nature of the archaeological record during this period needs to be reassessed, and in particular the dating of the apparent recolonisation during OIS 3 (White and Jacobi, 2002) and the subsequent arrival of modern humans. Key questions will be what environmental factors led to recolonisation, are there differences between Neanderthal and modern human habitats, and with what technologies are the modern humans associated? Fieldwork with the involvement of project members has taken place at Lynford (Norfolk) and Whitemoor Haye (Staffordshire), and is planned for Kent's Cavern (Devon).
6. **22,000 - 13,000 years: Human absence: The Dimlington Stadial faunal interzone.** Although this is the period of maximum ice advance, there are hints that the mammoth-steppe fauna of OIS 3 may have survived into OIS 2 – up to and beyond the last glacial maximum. The principal questions are whether humans were really absent at this time, if so at what stage did they disappear, and with what faunas are they associated? This will provide important information on the habitat tolerances of modern humans at this time.
7. **13,000 - 10,000 years: Recolonisation after the last glacial maximum.** The questions for this period focus on whether the recolonisation was punctuated or continuous, and if punctuated how this links to marked fluctuations in climate. Other questions include: what drove the Late-Glacial colonisation of Britain? Were humans moving seasonally within the landscape? Is there regionality within the archaeological and faunal records? Work has so far concentrated on the previously excavated site of Gough's Cave (Somerset).

### **Publication and dissemination**

The results of the research will be disseminated at different levels. Detailed research and site reports will be published as papers in academic journals over the five years. More generalised reports will appear on the project's website [http://www.nhm.ac.uk/hosted\\_sites/ahob](http://www.nhm.ac.uk/hosted_sites/ahob). Two Workshops are planned for 2003 and 2005 and will include other specialists working in the field. Finally, an overview of the results is planned as a monograph at the end of the project to coincide with a major conference in 2006.

### **Some relevant publications by AHOB members**

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**Andrew Currant (NHM):** *fossil mammals*  
**Simon Parfitt (UCL/NHM):** *fossil mammals*  
**Danielle Schreve (Royal Holloway, University of London):** *fossil mammals*  
**Simon Lewis (Queen Mary, University of London):** *Quaternary stratigraphy*  
**Jim Rose (RH):** *Quaternary stratigraphy*  
**Ian Candy (RH):** *environmental isotope RA*  
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**There are also a number of Associate Members of AHOB:**  
see [http://www.nhm.ac.uk/hosted\\_sites/ahob](http://www.nhm.ac.uk/hosted_sites/ahob)

## THE THIRD SUBFOSSIL CHIRONOMID WORKSHOP

7–9 November 2002, University of Exeter

The Third Subfossil Chironomid Workshop attracted to Exeter 28 researchers from Europe and N America. **Pete Langdon** (University of Exeter) opened proceedings by presenting his work on developing an Icelandic midge transfer function to reconstruct temperatures since deglaciation, Iceland. **Isabelle Laroque** (PAGES) discussed the results of her work testing the transfer function she has developed for Sweden. By reconstructing temperature over the last century at several sites and comparing these records against historical meteorological data since 1910, she suggested that the transfer function provided accurate temperature reconstructions on most samples. **Britta Lueder** (University of Bremen) described her work on a transect of ten lakes from sea level to the low alpine level in southern Norway. One of her aims is to determine whether the chironomids respond to climate or changes in lake sediment. Sub-arctic northern Finland is where **Marjut Nyman** (University of Helsinki) is working to reconstruct Holocene temperature change. Her lake record also shows clear hydrosere succession.

**Lydia Buttinger** (University of Durham) shared preliminary findings of analysis of cores from an ice-proximal lake in Greenland. Chironomid analysis throughout the core, which is thought to span the Holocene, will be complemented by pollen work in the basal segment of the core to assess the relative response rates of pollen and midges. **Naomi Holmes** (University of Exeter) outlined a proposal for a her PhD., which will involve using chironomids and pollen to reconstruct climate change in Iceland. The 8200 BP event in eastern North America was the topic of **Joshua Kurek's** (University of New Brunswick) seminar. He described the response of midge fauna in lakes at sensitive ecotonal boundaries. Both the chironomids and LOI indicated a significant drop in temperature at this time.

**Oliver Heiri** (University of Utrecht) showed research conducted to assess how much the faunal assemblage in surface samples varies over transects from the shore to the lake's deepest part. Results indicated that although differences existed, they were less significant than expected. **Alistair Brown** (University of Southampton) presented his plans to use chironomid temperature reconstructions from lakes in the UK to assess the influence of temperature on changes in the palaeohydrology of raised peat bogs. The value of chironomid exuviae in assessing modern faunas was described by **Les Ruse** (Environment Agency). He showed how this technique was amongst those used in monitoring the biological succession of a series of new lakes created by the Maidenhead flood defence scheme.

**Julietta Massafferro** (Natural History Museum) discussed chironomid analysis of Late Glacial – Holocene cores from Chile. Although a reappearance of Podonominae during the Younger Dryas chronozone indicated a possible cooling event, the work highlighted the need for more knowledge about midge ecology outside North America and Europe. Following on from this, **Sarah Gilchrist** (University of Edinburgh) described the development of a Patagonian training set and the analysis of records from within the region. **Roberto Quinlan** (University of Toronto) talked about his work looking at chironomids as indicators of eutrophication, dissolved oxygen levels, and recent climate change in southern Canadian boreal forest lakes. He reported the unexpected discovery that water management schemes that involve increasing the water level of deep lakes (>20 m) by just 2 m had a discernable impact on lake ecology. **Zoe Ruiz** (University of Exeter) summarised the diverse applications of chironomids that she has been working on. Emphasis was placed on her newest project – a pilot study assessing the potential of chironomid analysis as a tool to aid archaeological investigations. The presentation of recent work in Greenland, by **Klaus Brodersen** (University of Copenhagen), highlighted ways in which palaeoecologists should collaborate more with ecologists to understand more about environmental factors controlling chironomid distributions. He had run experiments to test the tolerance of larvae from various different taxa to different levels of oxygen depletion, the results of which challenged certain assumptions sometimes made whilst interpreting subfossil records.

**Steffen Mishke** (University of Berlin) discussed the initial findings of a pilot study using chironomids as part of a multi-proxy investigation on lakes from China and the Tibetan plateau. This study again highlighted the current paucity of taxonomic and autocological knowledge of chironomids outside Europe and N America. **Laurent Millet** (UFR Sciences et Techniques) presented chironomid records dating back to 26 ka BP from France and Germany, outlining the influences that trophic status are thought to have had on the changing assemblages. **Gaute Velle** (University of Bergen) discussed his work on a multi-proxy study to reconstruct Holocene climate temperatures in Norway. He emphasised the importance of knowledge of the modern ecology of midge species in interpreting past assemblages, particularly when relating these to other proxy records.

**Shirley Wynne's** (University of Exeter) presentation illustrated how the use of a temperature reconstruction produced for a site in NW Scotland, in conjunction with speleothem records, will allow her to constrain the interpretation of humification data from the area. **Maria Rieradevall** (University of Barcelona) shared the findings of recent work to produce a transfer function for the

Pyrenees. Her work indicates that the key variables influencing species distribution at her sites are altitude and lake depth but that chloride levels in the lakes are also important. **Vanessa Heider** (Technical University Carolo-Wilhelminia, Brunswick) presented findings from chironomid records she has produced from several lakes in Southern Sweden. She suggested that the change in assemblages present could well reflect changes in nutrient availability rather than temperature fluctuations.

**Everlyne Franquet** and **Emmanuel Gandouin** (University of Marseille) discussed findings of their recent attempts to assess the viability of using chironomids within palaeochannel studies. Use of midges, in conjunction with sedimentary and palynological evidence, gives evidence of former marine incursions in Northern France. **Alan Bedford** (Edge Hill College) presented results of chironomid analysis on a Lateglacial sequence from Hawes Water in Lancashire. The temperature reconstruction produced showed a striking correlation to the results of  $\delta^{18}\text{O}$  analysis on the sediments, enforcing current beliefs that midges are strong indicators of climate change. **Freddy Gathorne-Hardy** (University of Sheffield) outlined plans of a newly started project to use chironomids in conjunction with other insects to assess the impact of the Vikings on the North Atlantic Islands. **Steve Brooks** (Natural History Museum) explained details of one of his recent projects using chironomids to assess the impact of heavy industry in Russia on the water quality using a top and bottom approach on short cores taken from lakes in the area. The final presentation was by **Barbara Lang** (Edge Hill College), who described her work using chironomids, in conjunction with pollen analysis and  $\delta^{18}\text{O}$  records, to reconstruct Holocene temperatures for Hawes Water.

The individual presentations outlined above were supplemented with workshops and discussions on topics including taxonomic harmonization, recent advances in the process of sample preparation and selection of methods to quantify reconstructions. A key point to emerge from the meeting was the need to increase understanding of the modern autecology of taxa. Preliminary plans were discussed to collate the relevant data for the next workshop. Emphasis was also placed on distinguishing between direct and indirect responses of chironomid assemblages to climate change. More research is required to uncouple the temperature signal from that of a range of other variables.

**Barbara Lang** presented the encouraging results of trials she has been conducting to make the extraction of chironomids easier. By using ultrasonic treatment of samples the ease and uniformity with which the heads can be extracted from sediments, especially those samples that are carbonate or clay rich. There was also the discussion of methods to distinguish between taxa that are similar in appearance.

With respect to methods of quantifying records, there was much discussion as

to whether the conventional WA-PLS methods are the soundest way to reconstruct variables. It was suggested that the way forward is not to create larger training sets, covering a greater gradient of temperatures but to tailor the model to include only lakes with assemblages similar to the palaeo-assemblage in question.

The field excursion to Dartmoor provided a relaxing finale to workshop. Two quarries were visited where the products of tor formation could be viewed and the theories of formation mechanisms discussed. The group then climbed to Cox Tor to view the granite exposure, periglacial features and the unusual earth hummocks. No trip to Dartmoor would be complete without visiting Wistman's Wood. This National Nature Reserve is a stunted pedunculate oak woodland growing from a boulder-strewn slope. The ancient gnarled and twisted trees are covered with epiphytic lichen, mosses and ferns.

Many thanks must go to those that organised the workshop, Pete Langdon, Zoe Ruiz, Shirley Wynne and Naomi Holmes, for organising such a valuable, interesting and enjoyable three days in Exeter.

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**ISOCHRON RECONSTRUCTION FROM SALTMARSH  
SEDIMENTS: THE POTENTIAL OF POLLEN ANALYSIS. A  
CASE STUDY FROM CONNECTICUT, USA**

**Introduction**

Saltmarshes hold enormous potential for reconstructing sea-level fluctuations during the last few thousand years and offer a direct basis for comparing measured sea-level observations with those from the recent geological past. However, dating recent saltmarsh sediments can be problematic, particularly for the last *ca.* 200-300 years (cf. Houghton *et al.*, 1990).

This report details the preliminary findings of a study that evaluates the use of historically-delimited pollen 'markers' for dating recent saltmarsh sediments in at Menunketesuck River Marsh, Connecticut, New England, USA. This site was chosen because (1) the local history of landscape and vegetation change is well documented; (2) the pollen preservation is excellent; and (3) the marsh is a particularly sensitive site for recording sea-level change (O. van de Plassche, unpublished data).

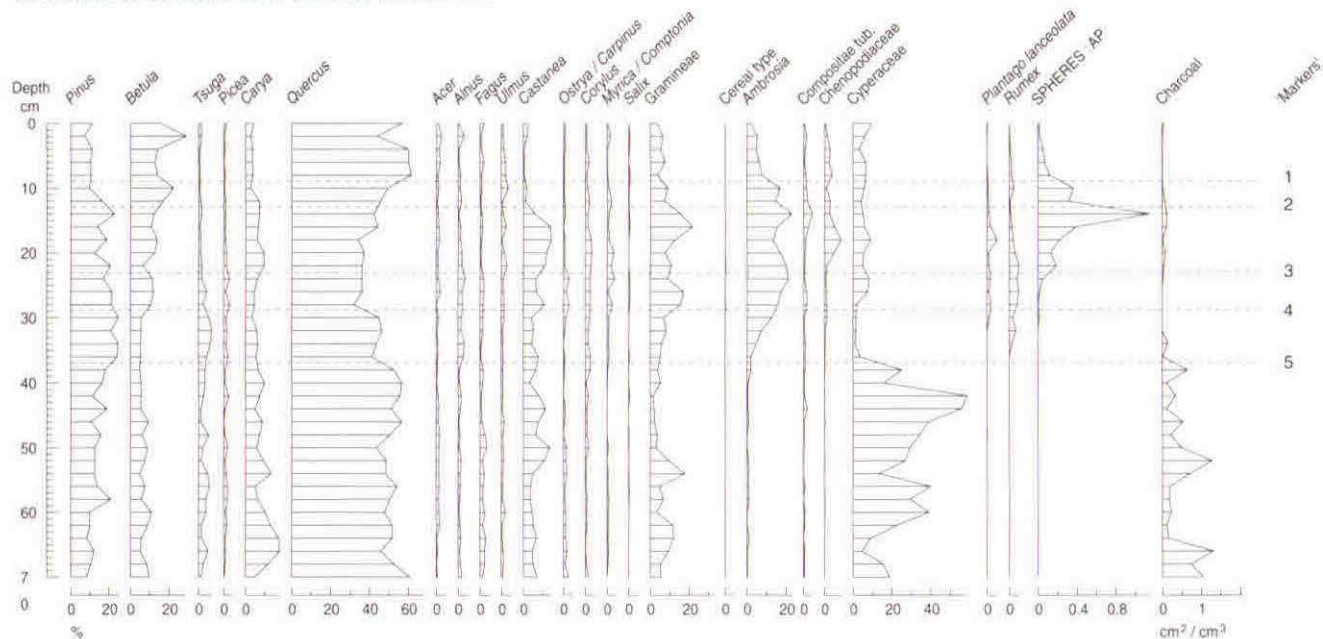
**Methods**

With the support of a QRA research grant, the Menunketesuck River Marsh was visited in August 2000 to (i) examine local historical archives and forestry records in order to constrain the ages of a series of regional pollen 'markers' previously identified at the site; and (ii) collect additional cores to test whether pollen biostratigraphy can provide an effective tool for correlating saltmarsh sediments on an intra-site scale. Surface samples were also collected to examine pollen taphonomy in the modern marsh. The archival work involved visits to local forestry, land registry and public records offices. Pollen samples were collected and have been analysed from four marsh cores and three surface transects.

**Results**

On the basis of the historical and other data it has been possible to constrain the ages of nine palynological and other 'markers' identified at Menunketesuck River Marsh. The most notable are shown in Figure 1. These include: 1) a decline in birch pollen dating from the 1940's-1950's; 2) a chestnut pollen decline dated at *ca.* 1915; 3) an expansion in 'opaque spheres' (cf. Clark and Patterson, 1984) which probably reflects the industrial development of two local towns during the latter quarter of the nineteenth century; 4) a decline in

## Menunketesuck River Marsh : Core 32



**Figure 1.** Pollen percentage data for core 32, Menunketesuck River marsh (selected taxa only). The pollen and other stratigraphical markers discussed in the text are shown. The opaque spheres are expressed as a ratio (sphere : arboreal pollen (AP) concentrations) following Clark and Patterson (1984).



*Quercus* pollen associated with the extensive felling of timber in the Menunketesuck River and adjacent catchments in the early to mid nineteenth century; and 5) an initial rise in *Ambrosia* (ragweed) pollen and pollen of other ruderals (e.g., *Rumex*) resulting from land clearance in the mid eighteenth century.

The surface pollen study has shown that regional pollen taxa have a reasonably even distribution in the modern saltmarsh, although some pollen grains (e.g., *Fagus*) are consistently over-represented in deposits near the upland border, whilst bissacchate grains (e.g. *Pinus*) show localised over-representation in creek sediments.

### Significance

The study confirms that historically defined pollen markers hold considerable potential for dating peaty saltmarsh sediments in New England (c.f. Brugham, 1978; Clark and Patterson, 1984). Unlike previous studies, the present study highlights the need to obtain local, catchment-specific historical data to improve the accuracy of age determinations. The study also shows that by analysing multiple cores, pollen markers can be used to construct isochrons ('timelines') for a single marsh. Thus pollen markers provide an excellent framework for i) establishing local marsh accretion rates; ii) examining temporal changes in microfossil distribution; and iii) independently cross-validating AMS radiocarbon and Lead-210 datasets.

### Acknowledgments

I would like to thank the many people who have assisted with this study: Orson van de Plassche (Vrije Universiteit, Amsterdam), Tom Webb, Paige Newby, Richard Lederer (Brown University, Rhode Island), Sandra Anagnostakis, Jeff Ward, Paul Waggoner (Connecticut Agricultural Experimental Station), David Smith (Yale School of Forestry), Emily Russell (Rutgers University, New Jersey), John Pfeiffer (Wesleyan University), Bob Bischoff, Dan Buell (Clinton Historical Society), Lawrence Reney (Old Saybrook Historical Society), Tim Parshall (Harvard Forest), John Hibbard (Connecticut Forest Park Association), Ron Rozsa (Connecticut Dept. of Environmental Protection), Janice Fuller (NUI Galway), Richard Orson, Oscar Manston and Gary Nolf. The QRA award was supplemented by a travel grant from Queen's University, Belfast.

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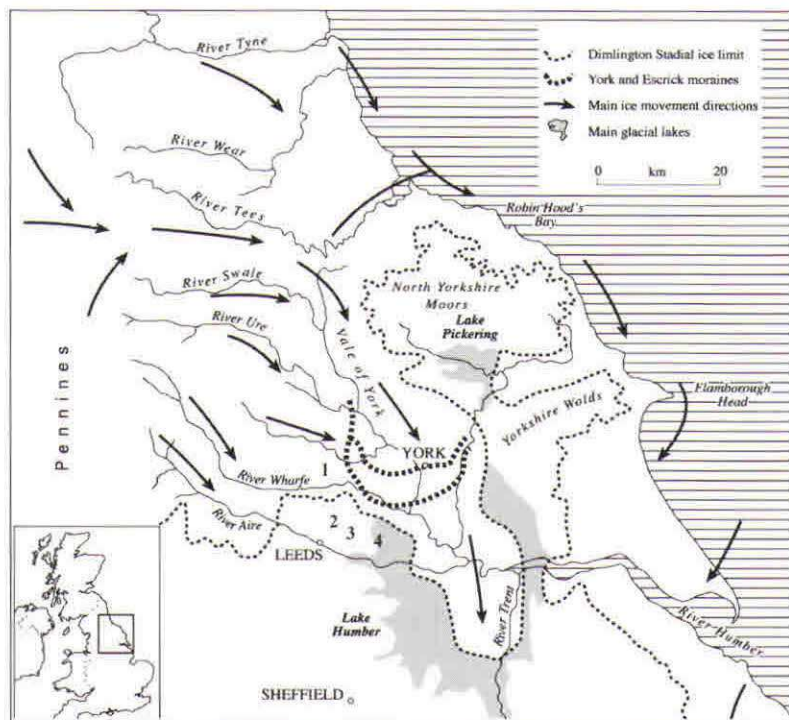
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## EXCAVATION AND ANALYSIS OF GLACIAL DEPOSITS IN WEST YORKSHIRE

### Project background and rationale

The area between the Vale of York and the Pennines was marginal to the last glacial maximum and is critical to our understanding of late Pleistocene environments in the UK (Gaunt, 1976; Straw, 2002). Glacial deposits of probable late Devensian age occur in the Wharfe and Aire valleys to the north and west of Leeds, whilst a number of dissected, decalcified patches at higher elevations to the south and east are regarded as pre-Ipswichian (Edwards, 1950; Catt, 1991; Lake *et al.*, 1992). The QRA New Research Workers Award provided funds to test pit and sample these sediments at four different sites (Figure 1). In total, ten test pits were excavated.



**Figure 1.** Location of sample sites with respect to late Pleistocene palaeogeographic conditions: 1. Low Barrowby, 2. Bramley Grange, 3. Silversides, 4. Becca Hall (Based on Catt, 1991).

## Methodology

In the field, the sedimentology of test pit exposures was described and where possible, fabric measurements undertaken. Laboratory testing of samples collected included clast lithological and particle-size analyses, x-ray fluorescence (XRF) and determination of calcium carbonate content.

## Results

Excavation of valley deposits inside the last glacial maximum limit (site 1) revealed 2 m of dark brown (10YR 3/3) stoneless, silty clay weathered yellowish red (5YR 5/8) to a depth of 1 m. Lithological analysis indicates that the deposit is composed of local Carboniferous material. Laboratory analysis indicates that the sediment is completely decalcified.

Test pits were excavated at three sites where sediments are considered pre-Ipswichian in age (Sites 2, 3 and 4). At sites 2 and 3, excavations revealed 2 m of a brown/grey (2.5Y 3/2) sandy diamicton weathered to a depth of 1.1 m. Clast fabric analysis suggests deposition by ice moving from north east to south west. Lithological analysis reveals Carboniferous and Permian clast content whilst XRF analysis shows the clay mineralogy of samples from sites 2 and 3 to be near identical. Calcium carbonate content of the <2 mm size fraction was 8% at site 2 and 6% at site 3.

At Site 4, 3 m of brown (10YR 5/3) clay containing weathered clasts of Magnesian limestone, sandstone and chert was recorded. The clay matrix contained 18% calcium carbonate (due to the proximity of the site to the Permian outcrop).

## Significance

Investigation of glacial deposits sampled from within the Last Glacial Maximum limit show them to be decalcified and to comprise only local lithologies. The degree and depth of the weathered profile is similar to deposits located outside the late Devensian glacial limit.

Analysis of the deposits outside the accepted late Devensian ice-limit indicates that they include both local and erratic material derived from ice moving from north east to south west. The deposits were weathered but included a significant  $\text{CaCO}_3$  component derived from Permian erratic material.

## Acknowledgements

Many thanks to landowners Malcolm Silversides, John Park and to Dr. Tavi Murray and Dr. Andy Howard for supervisory support.

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# CHIRONOMID RECORDS FOR THE LAST GLACIAL / INTERGLACIAL TRANSITION IN PATAGONIA

## Background

Last Glacial / Interglacial Transition (LGIT) temperature reconstructions are essential in identifying lags and leads between the northern and southern hemispheres during sub-Milankovitch-scale oscillations. Comparisons of such records may imply forcing mechanisms and modes of ocean-atmosphere teleconnection at this temporal scale. In general, palaeoclimatic records from different areas in Patagonia have supported contrasting hypotheses regarding such issues. Whereas some records support the proposal for global synchronicity of events during the LGIT (Denton *et al.*, 1999), others suggest that cooling in the southern hemisphere preceded that in the north (McCulloch *et al.*, 2000). Furthermore records from the Taito Peninsula have been thought to show no cooling events during the LGIT warming (Bennett *et al.*, 2000).

Temperature oscillations in Patagonia during the LGIT are complicated by inferred latitudinal shifts in the path of the Westerlies, which are thought to act as a proxy of Antarctic and the Southern Ocean palaeoclimatic conditions. If so, it may elucidate whether Antarctic ice-core records reflect climate change of the Southern Hemisphere as a whole or record the climate of Antarctica alone (Grootes *et al.*, 2001).

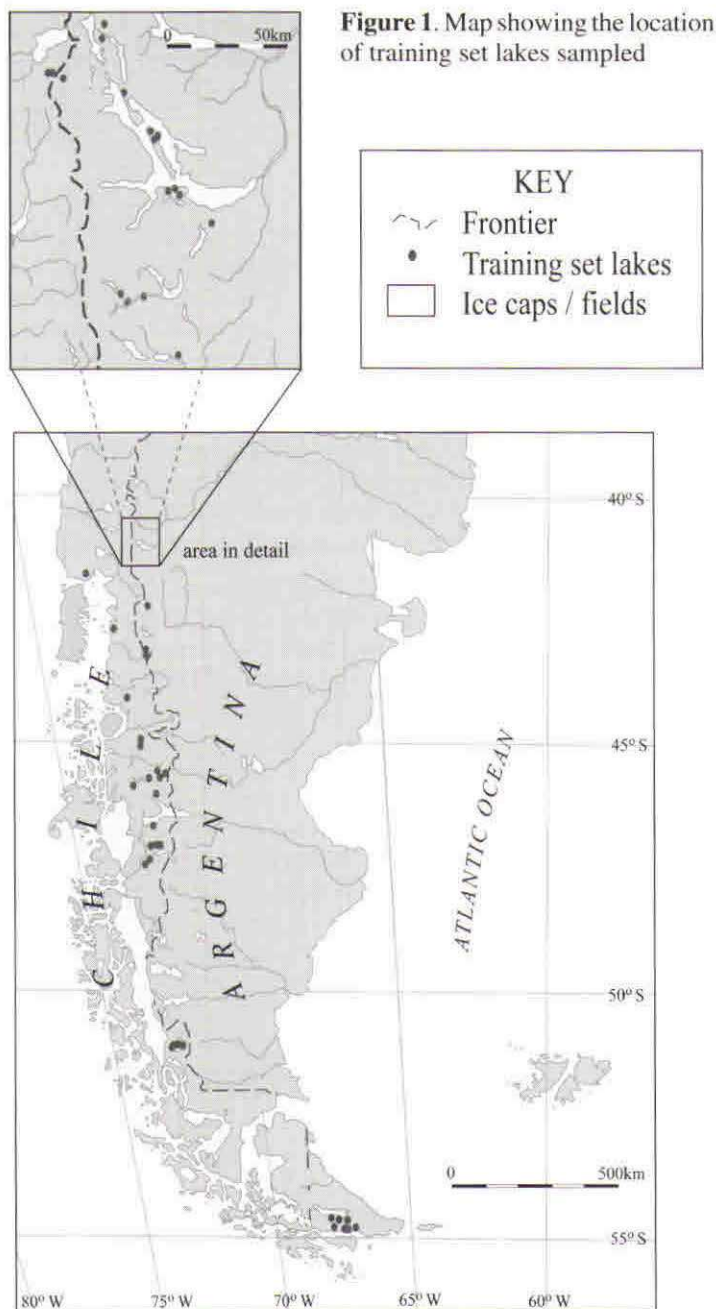
## Aim

This project aims to use chironomidae to improve our knowledge of Patagonian climate change. Their taxonomic sensitivity to temperature provides a potential tool to distinguish between the temperature and precipitation signals in Patagonia.

## Research programme and preliminary results

Modern surface-sediment samples and associated environmental measurements were collected in 2001-2 from 50 lakes in northern Patagonia and the Magellan region (Figure 1). Results will be collated and analysed to produce the first chironomid Patagonian training set.

One long core was taken from Lago Leta (73°09'53, 41°33'10") in the Chilean Lake District. The deeper parts of the core, suspected to be LGIT in age, show high-frequency fluctuations in the chironomid taxonomic assemblage. At a core depth whose age is estimated to be c. 8 ka BP there is also a major shift to an assemblage dominated by *Parakiefferiella*.



Statistical analysis of the modern samples together with associated environmental variables should provide an insight into modern chironomid ecology in Patagonia and new information on how the environment changed there during the LGIT.

### Acknowledgements

A QRA grant contributed significantly towards flight costs. Roberto Urrutia, Alberto Araneda and Andrea Rizo provided logistical and laboratory support and hospitality. Field assistance from Sarah Steele, Darcey Gillie, Julieta Massafferro and Bob McCulluch was invaluable, as is the continued supervision, support and taxonomic coaching from Steve Brooks.

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## LATE GLACIAL VEGETATION DEVELOPMENT AT NISI FEN, NORTHERN GREECE

Across south-east Europe, strong climate gradients and the presence of substantial mountain ranges today play an important role in determining vegetation distribution. Previous palynological work in Greece has shown patterns of past vegetation change which differ markedly from most other parts of Europe, for example, the apparent absence of a woodland recession during the Younger Dryas (e.g. Bottema, 1995). The aim of the project was to determine if these results were true reflections of climate change on a regional scale, or if geographic factors were responsible for modifying the expression of regional climate change in the vegetation record. Consequently, the project depended on high-quality sequences of fossiliferous material supported by robust chronologies. The QRA contributed to the costs of fieldwork at one of the sites studied, Nisi, a spring-fed, eutrophic fen occupying a 12 km<sup>2</sup> tectonic basin in central northern Greece. Five sequences of peat and limnic sediments, up to 15.63 m long, were retrieved using a Livingstone corer. A sound age model was provided using AMS determinations on seeds of the sedge *Cladium mariscus* and, in one case, macroscopic fragments of charcoal.

Radiocarbon dating and other analyses showed that the cores could be correlated to provide a complete palaeoenvironmental record to c. 15 000 <sup>14</sup>C BP. Throughout the Late Glacial part of the sequence, pollen of nearly all thermophilous tree taxa later observed in the Holocene record was present, albeit in small amounts. This suggests that at least parts of the catchment were capable of sustaining thermophilous taxa such as *Tilia* and *Fraxinus ornus* throughout the entire Late Glacial, while conditions were too severe to allow the more hardy deciduous species of *Quercus*, a key taxon in deciduous woodland communities in Greece, to occupy any considerable area. Expansion of deciduous trees did not begin in earnest at Nisi until c. 10 000 <sup>14</sup>C BP, when deciduous *Quercus* expanded extremely rapidly, followed more gradually by other thermophilous taxa.

The new data from Nisi show that, at least in some parts of south-east Europe, Late Glacial vegetation change did not follow the well-known patterns of northern Europe (cf. Mangerud *et al.*, 1974). Comparison of these data with recent palaeoceanographic work suggests that complexities of local climate gradients and topography may have modified regional patterns of climate change to produce a non-linear response in plant populations and, hence, pollen data. The results from Nisi, together with new data from other sites across Greece and a reconsideration of existing palaeoenvironmental data from the region, are currently being prepared for full publication following completion of the PhD project.

## **Acknowledgements**

The author thanks the QRA for assisting in meeting fieldwork costs. Further financial assistance was provided by a NERC studentship; the Phillip Lake Fund, Department of Geography, University of Cambridge; and Clare College, Cambridge.

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# GEOCHEMICAL COMPOSITION OF POST-ANGLIAN THAMES TERRACES

## Introduction

The Quaternary history of the River Thames is recorded in a staircase of river-terrace deposits. A lithostratigraphical classification of the terrace deposits has been proposed (Gibbard, 1985, 1994; Bridgland, 1994) based upon field mapping and lithological analyses of the coarse gravel fraction. The aim of this project is to investigate whether comparable sediment bodies can be identified on the basis of their sand and clay fraction geochemical composition.

The geochemical composition of the sand and clay fraction of the Thames sediment is believed to result principally from the input of sediment directly from the underlying bedrock and by tributaries with different provenance areas. Superimposed upon this are the products of weathering and soil-forming processes, which mix erosion products from the river itself with those derived from the slopes. As these latter processes have rates driven by climate, it is probable that systematic changes in composition may occur over Quaternary timescales.

## Methodology

In order to investigate the influence of different bedrock source areas on the sediment geochemistry, samples were taken over a wide range of locations in the Thames basin. The samples were extracted from sediments correlating to different Oxygen Isotope stages. Trace elements and major elements were measured by ICP-MS and ICP-AES analyses, respectively.

## Results

Clay minerals consists mainly of Al-oxides ( $\text{Al}_2\text{O}_3$ ); thus a sample with a fine (clayey) matrix should have a high  $\text{Al}_2\text{O}_3$  content. Coarser samples, in contrast, should have lower  $\text{Al}_2\text{O}_3$  amounts, but higher quantities of silica ( $\text{SiO}_2$ ) (Huisman, 1998; Tebbens, 1999). Unfortunately not all samples analysed for this project displayed this expected negative correlation. While samples from the Lower Thames show this correlation, samples from the Upper and Middle Thames show a positive correlation.

One explanation for this problem concerns the different preparation techniques used for the two analyses methods employed. All samples were prepared first for ICP-MS analysis using the standard techniques employed by the Kingston University facility. Analysis was then undertaken on the same samples using

the ICP-AES machine at Royal Holloway, University of London. Simple investigation of the two data sets quickly identified problems of comparability. Some samples showed a standard deviation higher than 10% on the silica data when analysed repeatedly; others showed total amounts well over 100%.

Discussion with the laboratories identified the probable source of the problem. Samples prepared for ICP-AES normally use an internal (gallium) standard in the preparation technique in order to stabilise the silica in the sample. This step is not used in the Kingston laboratory, thus giving unreliable sample results when they are subjected to the ICP-AES analysis. The only way to overcome this problem is to re-run the samples on the ICP-AES using a preparation with an internal standard, as planned.

### Acknowledgements

The Quaternary Research Association is gratefully acknowledged for its financial contribution to the field and laboratory work undertaken for this study.

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# **REVIEW**

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## **THE PENNINES AND ADJACENT AREAS: FOURTH EDITION**

**N. Aitkenhead, W.J. Barclay, A. Brandon, R.A. Chadwick,  
J.I. Chisholm, A.H. Cooper and E.W. Johnson**

**ISBN 0 85272 424 1 Softback 206 pages**

**Published by British Geological Survey 2002**

**£18, with 25 % academic discount when ordered from Sales Desk, British Geological Survey, Keyworth, Nottingham NG12 5GG  
Tel. 0115 - 936 3241 Fax. 0115 - 936 3488 (prices exclude post and packing)**

This guide is the latest edition in the long standing British Regional Geology series that first appeared in the 1930s to complement regional displays developed by the Geology Museum, South Kensington. In the last few decades some titles in the series have become rather dated, while the pace at which geological knowledge has expanded has been unremitting. Like painting the Forth Bridge, updating such an authoritative and useful series of clear geological overviews is a never-ending task. Unlike earlier editions it is now realised that the Quaternary can interest the more general reader and also requires better coverage, as ground conditions are of considerable importance to many users of geological data.

The Pennines form the topographic spine of northern England. This guide covers the southern two thirds of the Pennines and adjacent areas to the south of Cumbria, the Stainmore Pass and River Tees bounded by the Vales of Mowbray and York, Sherwood Forest, Nottingham, Ashbourne, Macclesfield and Chester, including the Irish Sea coast between the Wirral and Lancaster. This edition is slightly larger than usual, but wider margins waste much of this gain. While the use of bold to highlight key concepts and formations is welcome, the lack of spacing between sentences is wearing and the omission of references in the text is frustrating. No doubt this was done with the best of intentions, in order not to upset the more casual reader. However the text contains an increasingly complex range of stratigraphic divisions that can hinder rapid understanding by less advanced readers, who would find it far easier to skip such references that become invaluable when trying to gain a deeper understanding of the region.

The Quaternary comprises about a fifth of the text, a far greater emphasis than in the past, even if the geological succession in the introductory chapter still places the start of this period at 1.64 Ma (*Quaternary Newsletter*, 93, 56-58). The Neogene and Quaternary chapter starts with a few passing comments about the region's lack of post-Triassic deposits and isolated material preserved in solution hollows before setting out the Quaternary stratigraphical framework. This includes a most welcome figure correlating the deep-sea oxygen isotope curve with climate conditions and British Quaternary stages. However, the more detailed two-page tabulation of these events clearly shows that the quoted radiocarbon dates in the text are uncalibrated (Stuiver *et al.*, 1998), since 10 ka is given as the start of Flandrian postglacial times. In addition, there are two well drawn, informative and clear colour maps showing the extent of Late Devensian features and ice-flow directions, and also the extent of older deposits and glacial features in the southeastern area beyond the Late Devensian limit.

The guide provides a well written overview of the region's Pleistocene deposits and environments. A brief discussion about earlier events precedes a detailed account of the 'Older Drift' – now associated with the Anglian glaciation. Following this, the river terraces and other landforms developed before the Late Devensian glaciation are discussed along with the larger mammal faunas and evidence from cave deposits. This account is rightly put in the context of the sea-level changes, as ice sheets waxed and waned during the climate cycles. However, it does not emphasise that during glacial times global eustatic sea-levels dropped by up to 120 m below present levels and it ignores the effects that regional changes in the lithospheric loading might have on relative landscape levels. Eustatic uplift is an oxymoron as sustained erosion and the melting of ice sheets both result in regional isostatic uplift, and even changes in global sea level result in localised adjustments to surface levels.

A large portion of the chapter deals with the Late Devensian and the 'Newer Drift' deposits. This is a good account of the glacial processes and the resulting pattern of deposition and landscape modification which continued in the late glacial as the Devensian ice sheet waned and nearly returned during the Loch Lomond Stadial, when a number of cirque glaciers developed in the Pennines south of Kirby Stephen. The text is illustrated by some good colour photographs and a stunning satellite image centred on the Forest of Bowland, which shows the drumlin fields in the northwest of the region. The chapter concludes with the Holocene and the landscape modification resulting from peat-bog development, postglacial sea-level rise and agriculture.

The Quaternary is again touched upon in the extensive notes about the geology of the region's six main urban centres, including Liverpool, Manchester and Leeds. This is included in the Geology and Man chapter, which rightly attempts to show the relevance to society of geological studies. While this review has homed in on some significant oversights.

Overall, this is a splendid guide and a well-balanced geological introduction to the region. This improves on the earlier London and Thames Valley guide (*Geoscientist*, July 1997), that started this trend towards placing greater emphasis on the Quaternary and established the use of oxygen-isotope stage numbers within a more general text.-

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# **ABSTRACTS**

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## **MORAINE-MOUND DEVELOPMENT IN BRITAIN AND SVALBARD - THE DEVELOPMENT OF 'HUMMOCKY MORAINE'**

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The significance of British 'hummocky moraines' has been debated since a glacial origin was first recognised. Recent work has demonstrated morphological similarity between moraine mounds in Svalbard and Britain. Data obtained from investigations of moraine-mound sedimentology, morphology and structure at a contemporary glacier, Midtre Lovénbreen, Svalbard, are used to evaluate moraine mounds at a number of British sites. The Younger Dryas site of Cwm Idwal, Wales, and sites in the Cairngorm Mountains, Scotland, are used because moraine mounds here have been suggested to have developed by the same mechanism of englacial thrusting identified at some Svalbard ice margins.

The dominant moraine-mound facies at Midtre Lovénbreen is a clast-rich intermediate diamicton, but includes a wide range of facies types. The moraine mounds also exhibit a range of morphologies. Structural evidence indicates that a high englacial debris load of Midtre Lovénbreen was important in mound formation.

Moraine-mound facies at Cwm Idwal include clast-rich sandy diamicton and sandy gravel. A mound morphology characteristic of development associated with englacial thrusting is also recognised. Strong longitudinal compression and englacial thrusting may have been facilitated by ice flow against a steep, reverse bedrock slope.

Investigation of moraine mounds in the Cairngorm Mountains at Glen Avon, Coire Etchachan, Glen Derry, An Garbh Coire, Glen Geusachan and Glen Eidart indicates a dominant clast-rich sandy diamicton. Eight moraine-mound and ridge morphologies are characterised and include evidence of ice-marginal, englacial and proglacial development. The ice-marginal moraine mounds indicate periods of active deglaciation, which is recorded through to a final cirque glaciation stage at Glen Eidart and Coire Etchachan. Evidence of moraine-mound development associated with englacial thrusting is also found at Glen Eidart and Coire Etchachan, which may have been facilitated by glacier flow against reverse bedrock slopes. Ground-penetrating radar data suggest a dominant massive moraine-mound structure with peat infill between mounds. A single moraine at An Garbh Coire exhibits horizontal and undulating reflectors that are interpreted as crude bedding and glaciotectionised sediments.



# A PHYLOGENETIC AND PALAEOECOLOGICAL REVIEW OF THE PLEISTOCENE FELID *PANTHERA* *GOMBASZOEGENSIS*

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*Panthera gombaszoegensis* was a medium – large sized big cat, present in Europe between 1.9 and 0.3 Ma. It was first identified in 1938 by Kretzoi from the site of Gombasek in Slovakia. The only syntheses of this species were conducted 30 years ago and many more specimens have since been discovered. This thesis describes specimens from 23 sites studied at first hand and reviews all other published material. Taking the modern *Panthera* species as a baseline, morphometric and morphological variability is assessed and the results of these studies are applied to the fossils. A biogeographic analysis of the larger Pleistocene Carnivora is also conducted. Morphological differences in conjunction with a size increase were noted between older (1.9 – 0.8 Ma) and younger (0.8 – 0.3 Ma) *Panthera gombaszoegensis* specimens and these may be related to changes in prey size, guild membership and Pleistocene glaciations. The potential for genetic isolation and extinction of large mammals in Pleistocene refugia is considered and methods of furthering this research are discussed. The subdivision of *P. gombaszoegensis* into two subspecies is rejected and the possibility that *P. gombaszoegensis* is most closely related to the jaguar and tiger is addressed.

# **FLUVIAL RESPONSES TO RAPID CLIMATE CHANGE IN EASTERN ENGLAND DURING THE LAST GLACIAL PERIOD**

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The response of lowland fluvial systems to rapid climate changes has been investigated using as case studies the Rivers Nene and Welland, two medium-size lowland catchments draining into the Fenland Basin. This is particularly timely because recent evidence from ice-core and marine records suggests that climate was considerably less stable during the last glacial period (Devensian Stage, Marine Isotope Substage 5d – Stage 2) than previously thought.

Based on detailed description of sediments exposed in quarries in the two river valleys, site-specific sequences of facies associations have been identified which reflect changes in the fluvial system. They were correlated, using significant bounding surfaces and facies similarities, and used to construct catchment-scale sequences of fluvial activity during the period. Palaeontological analyses (plant macrofossils, pollen, Mollusca, Coleoptera) show that the river systems were active under a periglacial climate, with a nival discharge regime, grass- and herb-dominated vegetation of varying abundance, and sparse molluscan and coleopteran faunas adapted to arctic conditions. Age control on the sequences is provided by substantial numbers of both radiocarbon and optically-stimulated luminescence (OSL) age estimates, which were cross-calibrated by dating samples from the same channel-fills.

The Nene and Welland rivers were both active throughout the Devensian Stage, with lower-energy deposition in the Early Devensian Substage (~115–50 ka) than in the later Middle and Late Devensian Substages (~50–11 ka). A significant hiatus in sedimentation during the Late Devensian appears to relate to decreased fluvial activity and increased permafrost development at the Last Glacial Maximum (~22 ka), particularly in the Welland valley. These changes are similar to those recorded in other lowland British rivers, and systems across northwest Europe, although the type of sediments representing high- and low-energy conditions varies significantly.

It is concluded that there are clear responses to climate at the interglacial/glacial scale and to larger-scale trends and fluctuations within the Devensian such as those recorded by Marine Isotope Stages and Substages. However, river systems of this type do not respond to the small-scale Stadial/Interstadial events recorded in the Greenland ice-cores. In addition, this is the first study of Devensian fluvial sediments in lowland Britain to use OSL dating in conjunction with radiocarbon and has allowed the reliability of each technique to be assessed.

# ***NOTICES***

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## **1. THE XVI<sup>TH</sup> INQUA CONGRESS**

**23 – 30 July 2003, Reno Hilton Resort and Conference Center,  
Reno, Nevada, USA**

Full details of the Congress can be found on the Congress Web site:

[http://www.dri.edu/DEES/INQUA2003/inqua\\_home.htm](http://www.dri.edu/DEES/INQUA2003/inqua_home.htm)

Please visit this site to register your interest in the Congress and find out more about the location, scientific program and field trips.

Online registration and abstract submission for the XVIth INQUA Congress are now available.

We look forward to seeing you in Reno in 2003.

## **2. JOURNAL OF QUATERNARY SCIENCE**

**News:** A new facility regarding colour diagrams is now being offered by Wiley. It is now possible, at no extra cost to the author(s), to include colour figures in the electronic versions (pdf) of JQS articles even if in the hardcopy version of the same paper the figures are in half-tone or are black and white line drawings. Authors should flag their intention to take advantage of this facility to the editor at first submission of manuscripts.

JQS can be accessed online at: <http://www.interscience.wiley.com/jpages/0267-8179>

## **Forthcoming papers**

### ***Rapid Communication***

Macklin & Lewin. River sediments, great floods and centennial-scale Holocene climate.

### ***Research Papers***

Magny et al. Lateglacial and early Holocene changes in vegetation and lake-level at Hauterive/Rouges-Terres, Lake Neuchâtel (Switzerland).

Kjær et al. Mezen Bay - a key area for establishing a glacial event stratigraphy for the Weichselian in Northern Russia.

Garcia-Ruiz et al. Asynchronicity of maximum glacier advances in the Central Spanish Pyrenees.

Dill et al. Infilling of the Younger Kathmandu-Banepa intermontane lake basin during the Late Quaternary (Lesser Himalaya, Nepal) - a sedimentological study.

Wooller et al. Late Quaternary vegetation changes around Lake Rutundu, Mount Kenya, East Africa: evidence from grass cuticles, pollen, and carbon stable isotopes.

Vélez et al. Pollen and diatom based environmental history since the Last Glacial Maximum from Andean core Fuquene-7, Columbia.

Meyrick. Holocene molluscan faunal history and environmental change at Kloster Mühle, Rheinland-Pfalz, western Germany.

Bingham et al. Modelling the southern extent of the last Icelandic ice sheet.

Helmke et al. Evidence for a mid-Pleistocene shift of ice-drift patterns in the Nordic Seas.

Lewin & Macklin. Preservation potential for Late Quaternary river alluvium.

Whittington et al. Multi-proxy Devensian Lateglacial and Holocene environmental records at an Atlantic coastal site in Shetland.

Texier & Meireles. Relict mountain slope deposits of northern Portugal: facies, sedimentogenesis and environmental implications.

### ***Correspondence***

Glasser et al. Comment: Formation and reorientation of structure in the surge-type glacier Kongsvegen, Svalbard.

Woodward et al. Reply: Formation and reorientation of structure in the surge-type glacier Kongsvegen, Svalbard.

## QUATERNARY RESEARCH ASSOCIATION

The Quaternary Research Association is an organisation comprising archaeologists, botanists, civil engineers, geographers, geologists, soil scientists, zoologists and others interested in research into the problems of the Quaternary. The majority of members reside in Great Britain, but membership also extends to most European countries, North America, Africa, Asia and Australasia. Membership (currently c. 1,000) is open to all interested in the objectives of the Association. The annual subscription is £15 with reduced rates (£5) for students and unwaged members and an institutional rate of £25.

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

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

- President:** *Professor D. H. Keen*, Centre for Quaternary Science, Coventry University, Priory Street, Coventry CV1 5FB (e-mail: gex028@coventry.ac.uk)
- Vice-President:** *Dr R.C. Preece*, Department of Zoology, University of Cambridge, Downing Street, Cambridge, CB2 3EJ. (e-mail: r.c.preece@zoo.cam.ac.uk)
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- Publicity Officer:** *Dr H. Binney*, Environmental Change Research Centre, Department of Geography, University College London, 26 Bedford Way, London WC1H 0AP (e-mail: h.binney@ucl.ac.uk)

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

**QRA home page on the world wide web at:** <http://www.qra.org.uk>



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ISSN 0 143-2826