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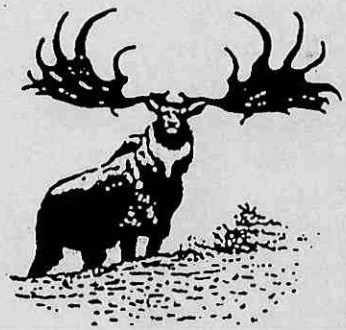

Editor: Janice Fuller

Introduction

This lengthy edition of the Newsletter includes more dates for your diary, abstracts of papers presented at the Spring Meeting (March 2002) and the Annual Symposium (November 2001), and details of recent publications. As ever, members are encouraged to continue to support the Newsletter by contributing items of interest. Contributions for the autumn edition should reach me by September 30th. Contact details are provided on the back page.

The next IQUA event will be the autumn field meeting that will probably be in Kilkenny. More details will follow once the final decision has been made.

On behalf of the membership of IQUA, I would like to congratulate Pete Coxon on becoming a Member of the Royal Irish Academy on March 16th.

Janice Fuller

Dates for your diary

1. INQUA-PAGES and Brunel International Conference:
"Holocene environmental catastrophes and recovery"

When? 29 Aug.-2 Sept. 2002
Where? Brunel University, London

An inter-disciplinary conference on past geological and environmental catastrophes, and their impact on our society.

See website for more details:
www.brunel.ac.uk/depts/geo/Catastrophes/

2. XVIth INQUA Congress 2003:
"Shaping the Earth: a Quaternary Perspective"

When? July 23-31, 2003
Where? Reno Hilton Resort and Conference Centre Reno, Nevada, USA

See website for more details:
www.dri.edu/DEES/INQUA2003

3. Short field meeting: The Quaternary of south-west Ireland

20th – 23rd September, 2002

Organisers: Tim Mighall and Stephan Harrison, Centre for Quaternary Science, School of Science and the Environment, Coventry University, Priory Street, Coventry, CV1 5FB. Tel. 024 76888420; Fax 024 76888447; E-mail t.mighall@cov.ac.uk or s.harrison@cov.ac.uk

Leaders to include: E. Anderson, O. Bloetjes, P. Coxon, S. Harrison, J. Lagaerd, T. Mighall, W.F. O'Brien, D. Passmore, M. Philcox, A. Richards, M. Waller, P. Woodman.

Registration
Participants should register at the Ashville Guest House in Killarney from 5.30pm on Thursday19th September or between 8-9 am on the 20th September.

Provisional itinerary
Day 1 Friday 20th September:
Macgillcuddy's Reeks
Gaddagh river valley terraces; Glenavy Stadial advance moraines; Hag's Glen alluvial fan; Bone protalus rock glacier
Day 2; Saturday 21th September:
Mizen Peninsula
Mount Gabriel copper mines; Vegetational history of Mount Gabriel lowlands; Toormore Bay Wedge Tomb; Vegetational history of Cadogan's Bog; Ratooragh
Day 3; Sunday 22nd September:
Killarney and Southern Co. Clare
Ross Island copper mines; Vegetation history of the Killarney lowlands; Gravel pits in the high-level terraces just NE of Killarney; Bridges of Ross; County Clare
Day 4; Monday 23rd September:
Brandon Mountain and the Dingle Peninsula
Connor Pass: introduction to Quaternary history of the area; Brandon Corrie alluvial fans; Feohanagh; Smerwick Harbour; Ferriter's Cove

IQUA Spring Meeting 2002, Abstracts of Papers

The gestation of a kettle hole
M.E.Philcox, Trinity College, Dublin

Kettle holes were common on the top of the gravel deposits that form part of the Blessington ice-contact delta complex. They are clearly visible on the 1970s air photos. Small bogs developed in some. In this talk the origin, development and infilling of the kettle holes are discussed.

The kettle holes occur mainly north-west of the delta itself in a facies belt (the Deerpark Facies of Philcox, 2000), which was a product of the main (westward) retreat phase of the ice sheet from the Blessington Readvance Moraine (Synge, 1977). Copious outwash gravels rapidly buried isolated remnants of the distal ice. These buried ice blocks melted very slowly, allowing progressive collapse of overlying gravels >40 m thick, forming sub-circular surface depressions several meters deep. Within the gravel succession, these "let-down structures" are typically borded by distinctive, inward-dipping and -throwing, en echelon step-fault complexes. Individual faults, though extensional, dip outwards, thus having reverse-fault geometry. Fault dips decrease upwards, and near surface can be less than 30°, where they could be mistaken for thrusts. Similar fault patterns can develop when magma chambers below volcanoes are evacuated, or when oil is pumped out of reservoirs (Branney, 1995).

One unusually large let-down structure in Dillonstown Tnld, which was sealed at the top by till and/or ironpan, resulted in a pond >120 m across. The pond was partly filled with a unit (1-4+ m thick) of poorly laminated gritty clay with coarse sand partings and organic detritus, which smoothed off most of the initial irregularities, partly by slumping. This was followed above a sharp contact by well laminated, light grey clay <80 cm thick, which thickened slightly towards the centre of the remnant depression. These lake clays were overlain by peat >3 m thick. Bulldozing, to remove this "overburden" from the underlying gravels, provided a cross-section >50 m across through the pond-filling succession, including in particular the margins. Preliminary pollen analysis by Tom Cooney (TCD) indicated that the clays and peat contained a well preserved late Glacial and Holocene sequence.

Bedding planes in the top few cm of the laminated clay show polygonal shrinkage cracks. These, and some larger fissures in the clay, are filled with "Black Jelly", identified as dopplerite, a calcium humate. This appears to have formed as a liquor seaping out of the compacting peat, and "jellyfying" within the cracks below.

The bulldozed cross-section revealed an asymmetrical basin, the gravel floor of which rose steeply (<20°) on the W side to a level 9 m above the centre and 4 m above the highest preserved peat. The bottom part of the peat near the west margin includes bands of stony sand reworked from the substrate, and tongues of organic peaty diamict (slumps) <50 cm thick. The uppermost tongue, 80 cm above the base of the peat, extends >18 m into the bog; up slope it rests

directly on the rising gravel substrate. One sand band was traced to within 3.5 m of the centre of the bog, where it lies 90 cm above the base of the peat. Thus substrate material, and presumably also pollen from the lake and early peat deposits, have been transported well into the bog from the steep W margin. Stored samples from this site provide an exceptional opportunity to study the effects of such slumping on the composition of the peat and on the pollen record. Would it have been detected in cored samples?

The Dillonstown kettle hole was thus conceived by the burial of ice blocks, developed as a "let-down structure" followed by the infilling of the resulting late Glacial pond, and completed its gestation as a peat bog. It has since "passed away" --- by lorry!

Branney, M.J., 1995, Downsag and extension at calderas: new perspectives on collapse geometries from ice-melt, mining, and volcanic subsidence"; Bull. Volcanol., 57, 303-318.

Philcox, M.E., 2000, "The glacio-lacustrine delta complex at Blessington, Co. Wicklow and related outflow features"; pp.129-152 *in* Graham, J.R. & Ryan, A. (eds.), "IAS Dublin 2000, Fielf Trip Guidebook", Internat. Assoc. Sedimentologists.

Synge, F.M., 1977, "West Wicklow", *in* Huddart,D. (ed), *South-East Ireland*, Internat. Union for Quat. Research (INQUA), fieldgude, 56 pp.

Holocene climate signals in a speleothem O isotope record from Crag cave, Co. Kerry

Frank McDermott, Department of Geology, University College Dublin

It is widely accepted that climate variability on timescales of 103 to 105 years is driven primarily by orbital, or so-called Milankovitch forcing. Less well understood is the cause of the sub-Milankovitch millennial-scale variability that characterises the $\delta_{18}O$ records of both the glacial and interglacial intervals of the Greenland ice cores (GRIP and GISP2). Recently, millennial-scale quasi-periodic episodes of ice-rafting have been documented in Holocene deep-sea sediments from the North Atlantic ocean, but there is little consensus about the precise timing, amplitude or cause of these events. Here we present a new high-resolution O isotope time-series record for a well dated stalagmite (CC3) from Crag cave in S.W. Ireland which shows that the early Holocene $\delta_{18}O$ variations in the Greenland ice cores reflect regional Holocene climate signals, but that most of the putative Holocene ice-rafting events in the N.Atlantic are not detectable in S.W. Ireland.

Approximately 1640 laser ablation $\delta_{18}O$ measurements were carried out along the growth axis of the 465 mm long Holocene stalagmite, resulting in an exceptionally high-resolution $\delta_{18}O$ record. Prior to 5 ky B.P. the resolution is about 2 to 20 times better than that of the published (two-metre segment) $\delta_{18}O$ data for the GRIP and GISP2 ice cores, and is about a factor of two worse that of the ice cores since approximately 5 ky B.P. Significantly, the average resolution is approximately an order of magnitude better than that of the N. Atlantic cores in which sedimentological and faunal proxies preserve evidence for quasi-periodic (1475 ± 500 year) ice-rafting during the Holocene.

$\delta_{18}O$ ranges from -11.65 to -0.82 ‰ (VPDB), but typically varies by ± 1.75 ‰ around a mean value of -3.26 ‰ (VPDB). The most important new result it that the so-called '8,200 year cooling event' is clearly discernible, centred on 8.32 ± 0.12 ky B.P. It exhibits an exceptionally large (c. 8 ‰) but short-lived (c. 40 year) decrease in $\delta_{18}O$. The amplitude of the shift to lower $\delta_{18}O$ is too large to ascribe solely to a reduction in mean annual air temperature. Instead it probably reflects a freshening of the surface of the adjacent N. Atlantic ocean by isotopically depleted melt-water. The chronology of our new record is consistent with suggestions that the '8,200' year event was triggered by a catastrophic release of melt-waters by sudden draining of large ice-dammed lakes on the margins of the Laurentide ice sheet in northeastern Canada, dated to 8.47 ± 0.30 ky B.P. Taken together with historically documented variability it appears that high frequency (multi-century) oscillations, perhaps reflecting N. Atlantic thermohaline circulation changes have a stronger impact on the climates of N. Atlantic ocean-margin sites than the lower

frequency (millennia scale) ice-rafting events recorded by ice-rafting proxies.

McDermott, F., Mattey, D.P., Hawkesworth, C.J. (2001) Centennial-scale Holocene climate variability revealed by a high-resolution speleothem $\delta_{18}O$ record from S.W. Ireland. *Science*, **294**, 1328-1331.

Palaeohydrologic response to the abrupt '8,200 year' cold/dry event recorded by trace element concentrations within stalagmite calcite from S.W. Ireland

James Baldini[1], Frank McDermott[1] and Ian Fairchild[2]
[1]Department of Geology, University College Dublin, (e-mail: james.baldini@ucd.ie)
[2]School of Earth Sciences and Geography, Keele University, Staffs ST5 5BG, UK

Previous studies have shown that speleothem trace element concentrations (Mg, Sr, P, etc.) can reflect changes in cave drip water availability (Fairchild et al., 2000; Huang and Fairchild, 2001). In order to reconstruct the palaeohydrologic response to the well documented '8,200 year' cooling event, trace element data were acquired at a very high spatial resolution (ca. 10 μm) in a U-Th dated Holocene stalagmite using an ion microprobe. An abrupt increase in Sr and a concomitant decrease in P were detected at 8,334 ± 124 cal. yr. B.P., coinciding with a large (ca. 8‰) decrease in oxygen isotope ratios and a petrographic change from inclusion rich to clear calcite, reflecting the '8,200 year' event in western Ireland. The change occurs abruptly in less than 1 year. Trace element concentrations remain at non-baseline values for approximately 37 years before suddenly returning to baseline values. This first-order shift in P and Sr may be the result of an increase in water-rock contact times and a decrease in vegetative activity due to a cold, dry climate.

Antipathetic variations in P and Sr within the first-order trace element excursion reflect seasonal changes in water availability and temperature. These second-order cycles are the correct wavelength to be annual, thus facilitating a high-resolution reconstruction of stalagmite growth rates. The lower growth rates gleaned from the resulting reconstruction are consistent with reduced meteoric precipitation and lower temperatures characteristic of the '8,200 year' event. Strontium variations have a greater amplitude within the event than either before or after the event, suggesting a more highly seasonal distribution in rainfall.

Fairchild, I.J., Borsato, A., Tooth, A.F., Frisia, S., Hawkesworth, C.J., Huang, Y., McDermott, F. and Spiro, B. 2000: Controls on trace element (Sr Mg) compositions of carbonate cave waters: implications for speleothem climatic records. Chemical Geology, 166, 255-269.
Huang, Y. and Fairchild, I.J. 2001: Partitioning of Sr2+ and Mg2+ into calcite under karst-analogue experimental conditions. Geochimica et Cosmochimica Acta, 65, 1, 47-62.

Sourcing the rocks on Newgrange's façade: granites from the north and quartz from the south.

I.G.Meighan [1], B.N.Hartwell[1], P.S.Kennan[2] & D.D.A.Simpson[1]
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[2]Department of Geology, UCD

Newgrange's 'highly controversial' façade has been reconstructed entirely from materials found on the site: rounded to oval cobbles (mostly granite) set in a matrix of angular 'vein' quartz fragments on a modern concrete support were originally brought from distant sources, north and south, during the Neolithic. Building on Professor Frank Mitchell's pioneering work (1992), most (some 554) of the cobbles on the façade have been examined petrologically with the following conclusions:

1) Newry and Mourne complex rocks together constitute approximately 88% of the cobbles on the façade with Tertiary Mourne granites (approximately 45%) more abundant than Caledonian Newry granodiorites (approximately 41%). 6% of the Mourne rocks are drusy and 37% of the Newry granodiorites are foliated.

2) Although all five Mourne Mountains granites may be represented, over 80% of the Mourne material is the Eastern Centre granite G2. By contrast, on-site examination (without geochemistry) precludes the assignment of specific Newry granodiorite cobbles to any one of the three such plutons in this complex.

3) Other rock types (12%) include microgranites (porphyritic and aphyric), gabbro and dolerite whose likely sources are the Carlingford/Slieve Gullion Tertiary central complexes. Some of the gabbros display cumulate layering. Interestingly, there are no granitic cobbles of Leinster, North Arran or Ailsa Craig derivation.

61% of the cobble population examined has a smooth (as opposed to rough) surface and overall the most likely source seems to be the northern beaches of Dundalk Bay where the material has been eroded from Pleistocene boulder clay. Perhaps the tomb builders used water transport to take the cobbles on their final journey to Brú na Bóinne? The excess material (cobbles and vein quartz) lies loose on the roof of the tomb immediately above the façade where Newry granodiorite cobbles are much more abundant than Mourne granite ones (in the ratio of approximately 8:1). Clearly our study shows that the modern reconstructionists had a marked preference for the lighter, approximately spherical Mourne cobbles as opposed to the darker, oval Newry ones. Overall (façade and roof), Newry granodiorite and not Mourne granite is the dominant cobble lithology at Newgrange.

In the literature Newgrange's voluminous white 'vein' quartz material has been ascribed to sources in the Wicklow Mountains. Most is in the form of angular fragments but there are a few water-rounded quartz cobbles. Some of the façade fragments include 'dark schist' material, others muscovite mica. Some are bluish in colour, others are distinctly reddened. Overall our study shows that macroscopically most of the quartz at Newgrange can be matched with the quartz (typically in the form of pods) in the schistose **aureole** of the Leinster granite. Relatively little seems to have been derived from quartz veins in the granite itself or its mineralised areas. Stable isotope (oxygen, hydrogen) and fluid inclusion studies are in progress to test these conclusions.

Newgrange's façade thus seems to combine granitic and other cobbles exclusively from northern sources and quartz entirely (?) from southern ones. Hence this classic megalithic passage tomb at Brú na Bóinne appears to manifest the convergence of north-south Neolithic landscapes (and perhaps cultures) on the island of Ireland.

Meighan, I.G., Simpson, D.D.A. and Hartwell, B.N. 2002. Newgrange: Sourcing of its granitic cobbles. Archaeology Ireland, in press.

Meighan, I.G., Hartwell, B.N. and Simpson,D.D.A. The Newgrange megalithic passage tomb façade – the petrology of 'Neolithic cobbles'. Irish J. of Earth Sciences (abstract, in press).

Mitchell, G.F. 1992. Notes on some non-local cobbles at the entrances to the passage-grave at Newgrange and Knowth, County Meath. J.of the Royal Society of Antiquaries of Ireland 122, 128-45.

Soil Parent Material mapping reveals a revised perspective of areas with limestone bedrock in Ireland

Robbie Meehan, Teagasc, Kinsealy Research Centre, Malahide Road, Dublin 17

One of the most basic subdivisions recognised when classifying soils is the distinction between acidic and basic soils. Soils in Ireland have historically been mapped using conventional soil survey methods: classification into series and groups, from the characteristics of the solum ('A' and 'B' horizons) only. Soil parent materials were mapped within this scheme, but without an expertise in Pleistocene geology, crucial as more than 70% of Irish soils are derived from Pleistocene deposits (various types of glacial tills, glaciofluvial sands and gravels and lake clays). Hence, the soil parent materials were inferred from the sola, rather than the other way round.

Within the FIPS - IFS project (1998-2002), Irish soil parent materials are mapped as glacial and Holocene deposits, concentrating on the characteristics of the 'C' horizon, or true parent material of the soil itself. Soil type is then inferred from the parent material class (the important soil characteristics being mineral/organic status, chemical reaction and depth). This provides a unique opportunity to examine the chemico-physical properties of soils in Ireland derived from varying parent material types.

One of the most important intermediary results within this FIPS – IFS project has been the recognition that over many areas of limestone bedrock in Ireland (e.g. the Cork synclines, north Roscommon, south Donegal, east Galway, west Sligo) many of the soils are actually derived from acidic parent materials which have been carried and deposited by ice over this basic bedrock (sandstone dominated tills and gravels mostly). This means that many of our most fertile soils are not in fact grey-brown podzolics and brown earths of hi-base status as was previously thought (and depicted on previous soil maps) but in fact acid brown earths and brown podzolics. The talk will examine the soils found in the areas mentioned above, and some of the wider implications of this for soil science studies (and indeed glacial geologic studies) in Ireland.

Gardiner, M.J. and Radford, T, 1980. Soils Associations of Ireland and their land-use potential. An Foras Taluintais, Dublin.

Warren, W.P., 1991. Till Lithology in Ireland. In Ehlers, J., Gibbard, P. and Rose, J., Glacial deposits in Great Britain and Ireland. Balkema, Rotterdam.

Culleton, E.B., 1978. Characterisation of Glacial deposits in South Wexford. Proceedings of the Royal Irish Academy, 78B, 293-308.

Culleton, E.B., 1976. Pleistocene deposits in South Wexford and their classification as soil parent materials. PhD Thesis, Dublin University.

Clark, C.D. and Meehan, R.T., 2001. Subglacial bedform geomorphology of the Irish Ice Sheet reveals major configuation changes during growth and decay. Journal of Quaternary Science, 16(5), 483-496.

History of a presently acidic lake in eastern Ireland (Kelly's Lough, Co. Wicklow) determined through analysis of the sedimentary record

Manel Leira, Edwina Cole & Fraser Mitchell, Department of Botany, Trinity College Dublin

The Holocene sedimentary record from Kelly's Lough has been analyzed to determine the development of this presently acidic lake. Acid conditions seem to have prevailed in Kelly's Lough throughout its entire history. The diatom inferred pH reconstruction show that there is a long-term acidification, which can be associated with a reduction in the base status of the catchment soil. Despite the fact that the lake is sensitive to changes in acidity, the extensive development of peats did not cause an important decline in lake water diatom inferred pH. The changes observed in diatom assemblages may be due to an increase in turbidity related to inwash organic material from peat erosion since there are important changes in the composition of the planktonic diatom assemblage. The diatom changes that occur from 20 cm upwards need a more detailed study, but the inferred pH profile shows a decline of 0.7 pH units. This profile can suggest recent acidification.

Late Devensian Glacial Events in North Antrim

Stephen McCarron (stevemccarron@eircom.net)

The principal direction of glaciation in north Antrim during the Late Devensian period was from south to north, from an ice dispersal centre in the Lough Neagh Basin. The drumlinisation/streamlining associated with the last stages of this ice sheet activity is probably coeval with the regional-scale readvance of Irish ice sheet margins during Heinrich event 1 (McCabe *et al*, 1998). Morphostratigraphic evidence also exists for a Late Devensian glaciation of the region by ice of Scottish provenance. It is inferred from the evidence available that this readvance of Scottish ice occurred soon after the drumlinisation of north Antrim by Irish ice. The sequence and relative timing of these events have implications for the interpretation of important deposits in north Antrim and the widespread response of the last BIS to the causes of Heinrich event 1.

The anatomy and history of a small glen.

Amhlaoibh O h-Aonghusa, 11, Wainsfort Road, Dublin 6w

About 14 km southwest of Cork City a small stream about 1.3 km long enters the Owenabwee River from the south. It drains a small upland hollow via a steep-sided glen through an intervening ridge. The glen at its deepest point is about 20m deep, and the sides at this point slope

at about 1 in 2. The upper edges of the glen are quite sharp, indicating that erosion of the glen is still continuing. In its cross-section the glen shows a form common to all the valleys of this region: a valley within a valley, due to a major rejuvenation. There is evidence of considerable solifluction on both sides of the glen. The bottom of the glen is not of a sharp vee shape but has a small flat portion. Due to its swampy nature, there were no roads along the Owenabwee valley until around 1800 A.D. An early east-west road ran along the southern slope of the valley, crossing the lower end of the glen, and farmsteads were situated along this road.

The old east-west road would appear to have been in use in the 13th century, as the Normans began to build a "strong house " near the lower end of the glen around 1280 A.D., apparently to control this road and a crossing point of the Owenabwee valley, but they abandoned the attempt. At a later date, possibly in the 16th century, a new east-west road was built to the south and the old one fell into disuse. A road or lane was built along the left side of the glen to give access to the new road, but it was too close to the edge at one point and it became unusable due to solifluction at some stage. Another road was built on the east side of the glen to replace it, keeping well back from the edge of the glen, and it is still in use, and known as the "Strip". The upper end of this road probably formed the avenue of a Cromwellian settler, a Yorkshire man, Edward Riggs, who had a house here until the Williamite wars. He gave his name to the townland of Rigsdale, and the name of the road is probably also a legacy of his.

The upland hollow drained by the stream is floored by a layer of drift, containing erratics foreign to the area: Old Red Sandstone, vein quartz, and a cherty breccia. It formerly carried a peat bog, of which only traces now remain. The stream through the glen, until about 40 years ago, had a bottom of firm mud. A heavy rainstorm in 1962 initiated erosion of the bed at the upper end of the glen which is still continuing. This erosion was possibly initiated by a line of trees planted on the right bank about 80 years ago, the roots of which would have impeded the supply of soliflucted material from that side. Over a distance of some 100m the erosion has exposed seven logs of wood 20 to 30cm in diameter, many smaller pieces, and one stump in situ in the centre of the stream bed. The wood overlies a layer of stones many of which are not of local origin, and appear to have been derived from the drift in the upland hollow. Two pieces of wood have been carbon dated by Eddie McGee and have yielded dates of 1540 and 3150 B.P. Both were oak. The wood is overlain by a uniform grey clay up to 2m deep. This would appear to be the product of solifluction, and would indicate that at some stage the rate of solifluction exceeded the capacity of the stream to transport the material, which then built up and overwhelmed the trees. The reason for this is not clear.

Abstracts from the Annual IQUA Symposium 2001

The distribution and clay mineralogy of Tertiary(?) weathering products in northwest County Donegal

Stuart Bennett and Jane Butler, Department of Geology, Trinity College, Dublin 2

Glaciers have failed to remove large amounts of granite saprolite in the vicinity of the Bloody Foreland, northwest County Donegal. Sites of deep chemical weathering are described from the Thorr/Rosses Granites and Dalradian country rocks, and relationships with topography are discussed. Clay mineralogical analysis of the weathering products has been carried out using X-ray diffraction (XRD) methods to gain insight into the palaeoclimatic weathering regime.

The landscape comprises resistant peaks (Ards Quartzite) in the east and a low-lying plain (Thorr/Rosses Granites) running to the coast in the west. The most intensely weathered granite exists in the flanks of quartzite topographic highs at or close to the contact with the granite, for example, the flanks of Bloody Foreland and Tievealehid. At such sites the granite has almost completely weathered to clay, and has a predominant kaolinite and smectite mineralogy. This can be attributed, in part at least, to the action of acidic groundwater meeting the granite after descending from the quartzite high ground.

At sites further away from the contact, weathering has either not been as intense or has not had sufficient time to reach the 'kaolinite'

stage. At the Bloody Foreland, the cliffs of granite are deeply reddened at the base and at the top are formed by crumbling saprolite below a water lain till cover. Clay weathering products include small amounts of kaolinite and smectite and corestones are seen in situ at various stages of development.

Such weathering probably took place under conditions warmer and more humid than those currently prevailing. However, the profiles are thought to be too thick to have formed during the relatively warm interglacial periods of the Quaternary, and are therefore thought to be late Tertiary in age. They have been preserved from glacial scouring in part beneath till, and elsewhere in the 'protective shadow' of the quartzite peaks.

Ireland's Late Tertiary and Pleistocene landsurface: Modified or what?

Pete Coxon, Department of Geography, Museum Building, Trinity College, Dublin.

The evidence for widespread glaciation in Ireland is there for all to see with mountain, valley and lowland erosional and depositional glacial landforms ubiquitous in the landscape. The glacial modification of the Irish landscape has been the subject of study for over 100 years and modern techniques, including the use of remotely sensed images and digital terrain models, bring the extent of the landscape alteration (erosional and depositional) into sharp focus (e.g. Clark and Meehan 2001). However, numerous sites exist that contain evidence that some parts of the Irish landscape have escaped extensive modification during the Quaternary Period and that surfaces and surficial or near-surface deposits have survived in situ since the Neogene or before. Such surfaces (some of which are dated), that have survived intense glaciation, have been recorded from other areas of northwest Europe including Scandinavia (e.g. Lidmar- Bergström et al. 1997) and Scotland (e.g. Hall 1991, Hall and Sugden 1987) and so their presence in Ireland should not really be that surprising.
This paper will look at some of the evidence for pre-glacial palaeosurfaces and near surface sedimentation on limestone bedrock (e.g. Coxon and Coxon 1997, Drew and Jones 2000, Simms and Boulter 2000) and on other rock types in western Ireland (e.g. Coxon, in press). Tertiary surfaces and sediments will be seen to have been slightly modified by ice action but only minimally with a few metres of Quaternary diamicton being the only cover. The paper will also look briefly at the geomorphological position of some Irish interglacial sequences in order to see if it is possible to assess the level of post-Neogene landscape modification (e.g. Dowling and Coxon 2001).

Coxon,P. (in press) Understanding Irish landscape evolution: Pollen assemblages from Neogene and Pleistocene palaeosurfaces in western Ireland. In Mitchell, F.J.G. (ed.) Proceedings of the Royal Irish Academy. (Special volume in honour of Prof. William Watts' 70th birthday.)

Coxon,P. and Coxon,C. 1997. A pre-Pliocene or Pliocene land surface in County Galway, Ireland. in M.Widdowson. (ed) Palaeosurfaces: Recognition, Reconstruction and Palaeoenvironmental Interpretation. Geological Society Special Publication No. 120. pp. 37-55.

Clark,C.D. and Meehan,R.T. 2001. Subglacial bedform geomorphology of the Irish Ice Sheet reveals major configuration changes during growth and decay. Journal of Quaternary Science, 16(5), 483-496.

Dowling, L.A. and Coxon,P. 2001. Current understanding of Pleistocene temperate stages in Ireland. Quaternary Science Reviews. 20, 1631-1642.

Drew,D.P. and Jones,G.Ll. 2000 Post-Carboniferous pre-Quaternary karstification in Ireland. Proceedings of the Geologists' Association, 111, 345–53.

Hall,A.M. 1991. Pre-Quaternary landscape evolution in the Scottish Highlands. Transactions of the Royal Society of Edinburgh: Earth Sciences, 82, 21-26.

Hall,A.M. and Sugden,D.E. 1987. Limited modification of mid-latitude landscapes by ice sheets: the case of northeast Scotland. Earth Surface Processes and Landforms, 12, 531-542.

Lidmar-Bergström,K., Olsson,S. and Olvmo,M. 1997 Palaeosurfaces and associated saprolites in southern Sweden. in M.Widdowson. (ed) Palaeosurfaces: Recognition, Reconstruction and Palaeoenvironmental Interpretation. Geological Society Special Publication No. 120. pp. 95–124.

Simms,M.J. and Boulter,M.C. 2000 Oligocene cave sediments in Co. Cork: implications for reconstructing the Tertiary landscape of southwest Ireland. Proceedings of the Geologists' Association, 111, 363-372.

Deglaciation and the landscape of the Irish Midlands

Catherine Delaney, Dept. of Environmental and Geographical Sciences, Manchester Metropolitan University, Chester St., Manchester M1 5GD

This paper contrasts the topography of two areas in the Irish Midlands which are dominated by deglacial landforms, particularly eskers. The differences in the deglacial landscape between the two areas are explained by a combination of variation in a suite of glaciological conditions during landform formation, and interaction between the ice sheet and bedrock topography during deglaciation.

The glacial landscape of the northern area, east of Lough Ree, is formed by streamlined bedforms which are overlain by parallel-trending eskers formed time-transgressively, and hummocky moraine consisting of stagnant ice landforms and esker remnants. The landsystem is typical of stagnation zone retreat after a drumlinising event. The bedrock is rarely exposed, and it's influence on esker alignment is variable: in the south, the Streamstown esker is aligned perpendicular to the bedrock surface slope; northwards, the eskers are aligned parallel to pre-existing valleys and streamlined bedforms, while rare bedrock protrusions are associated with lee side deposition of glacifluvial sediments.

The southern area, between Kilbeggan and Tullamore, is dominated by three large eskers, with associated kames and small transverse ridges, but with no evidence of streamlined bedforms. The eskers are composed of subglacial tunnel deposits, flanked by glacifluvial sediments interpreted as ice-walled channel deposits. Flat-topped kames are interpreted as remnants of glacifluvial outwash plains, while transverse ridges are interpreted as terminal moraines. The landsystem has been interpreted as interlobate in origin (Warren and Ashley, 1994). However, no evidence was found to indicate the presence of a southern lobe. Instead, the convergence of the eskers towards the eastern end of the area may indicate the impact of buried bedrock topography on ice sheet drainage pathways in this area.

Warren, W.P. and Ashley, G.M. 1994. Origins of the ice-contact stratified ridges (eskers) of Ireland. Journal of Sedimentary Research, A64, 433-449.

Glaciation and the evolution of the Irish landscape

Jasper Knight, Glacial Research Group, School of Biological and Environmental Sciences, University of Ulster, Coleraine, Co. Londonderry

The distinctive upland, lowland and coastal landscapes of Ireland both record and have evolved in response to the effects of glaciation during the late Midlandian (Devensian) period (25,000-13,000 BP). The physical characteristics of these three landscape types reflect different sets of geomorphic processes operating during glacial and postglacial periods. For example, upland landscapes (>200 m OD) are mainly characterised by glacially-smoothed and streamlined bedrock surfaces, occasionally with moraines, ice-marginal deltas or kame terraces. Lowland landscapes (<< 200 m OD) are mainly drift-dominated and characterised by overprinted patterns of ribbed (Rogen) moraines and drumlins upon which may be superimposed eskers, moraines and outwash fans deposited during ice retreat. Coastal landscapes may contain both erosional upland and depositional lowland components which may be masked by the effects of postglacial sediment reworking by changes in sea-level, leading to coastal sand dunes, beaches and salt marshes which are often associated with estuaries and embayments.

These upland, lowland and coastal landscapes also have different ecological, archaeological, agricultural and settlement patterns; components that give them their unique cultural 'character'. Landscape character in these settings, which is

largely preconditioned by glacial activity, can be formalised into hierarchical 'geocultural regions' or landscape spatial units. These geocultural regions can effectively link together geological and cultural landscape components and can be used as the basis for geological and landscape conservation and management.

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Subglacial bedforms in Ireland - What do they tell us ... ??

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[2]Department of Geography& Sheffield Centre for Earth Observation Science (SCEOS), University of Sheffield, Sheffield, S10 2TN, UK

Bedforms have been important features used in reconstructing ice flow dynamics in Ireland since Maxwell Closes pioneering work of the mid-nineteenth century (1867). Since then, work has concentrated almost exclusively on drumlins, especially their axial directions, geometry, and internal sedimentary characteristics. These studies have led to highly contrasting views of the palaeo flow patterns of the Ice Sheet.

The development of this drumlin mapping over time is examined with several key studies mentioned, and these works are compared to contemporaneous developments in subglacial studies worldwide. Important in this comparison is the issue of the scale of importance of the bedforms, related to other evidence such as striae and erratic carriages. The idea that the marriage of these three ice flow indicators may not provide the best reconstruction of the ice sheet is examined, and this topic leads into a review of recent mapping of bedforms in Ireland using satellite images, and including ribbed (Rogen) moraines (e.g. McCabe et al., 1998).

The belated realisation that these ribbed moraines form such an integral part of Irish geomorphology and the piecemeal approach to previous drumlin mapping is probably responsible for the highly contrasting views of flow patterns. Results from recent work using a high resolution (25 m) digital elevation model is presented, including morphological maps of a large part (100 x 100 km) of the so-called 'Drumlin Belt' of north central Ireland. The landforms actually comprise ribbed moraine for the most part, much larger than found elsewhere (up to 16 km in length), and which in places are superimposed on each other. Contrary to most prior assessments we find the bedform record to contain numerous and overlapping episodes of bed formation (ribbed moraine, drumlins, crag-and-tails) providing a palimpsest record of changing flow geometries. Using these distinctive flow patterns and relative age relationships between them ice sheet evolution into four phases during a single glacial cycle in Ireland can be reconstructed.

In Phase-1 (early in glacial cycle) Scottish and local ice coalesced forming a NE-centred Irish Ice Sheet. As it grew its centre of mass migrated southwards culminating in a major N-S divide positioned down the east of Ireland (Phase-2, ca. Last Glacial Maximum). During retreat, the centre of mass migrated at least 120 km northwards and became established in NW Ireland and at this point a dramatic bedforming event produced one of the world's largest and most contiguous ribbed moraine fields (Phase-3). Final deglaciation is thought to be by fragmentation into many topographically-controlled minor ice caps (Phase-4). Rather than any dramatic or unexpected behaviour, the reconstructed phases indicate a relatively predictable pattern of ice sheet growth and decay with changes in centres of mass, and does not require major readvances or ice stream events.

The final part of the talk looks at the future of this bedform mapping exercise, and cites examples from elsewhere in Ireland which seem to contradict what was previously thought.

The implications of this mapping for studies of bedforms elsewhere is also discussed.

Close M.H. 1867. Notes on the general glaciation of Ireland. Journal of the Royal Geological Society of Ireland 1: 207-242.

McCabe A.M., Knight J., McCarron S.G. 1998. Evidence for Heinrich Event 1 in the British Isles. Journal of Quaternary Science 13 (6): 549-566.

Irish ice meets limestone landscapes: Glaciokarst or glaciated karst?

Mike Simms, Department of Geology, Ulster Museum, Botanic Gardens, Belfast BT9 5AB

More than half of Ireland's surface is underlain by Carboniferous rocks, much of it limestone. Hence any consideration of landscape must consider how ice and limestone have interacted in Ireland. The sharp distinction between the predominantly limestone lowlands and non-limestone uplands appears to be largely 'pre-glacial'. The limestone uplands of the Burren, the Sligo-Leitrim area, and elsewhere are somewhat anomalous and owe much of their relief to relatively recent (?glacial) stripping of clastic cover sediments. Both have been extensively glaciated during the Pleistocene but support strikingly different landscapes. Glacial erosion of contiguous weathered clastics may be rapid but limestone itself has a relatively high mechanical resistance to direct glacial abrasion - but it has other weaknesses.

The Burren retains a strong 'pre-glacial' signature of large-scale karst landforms, even in areas which have experienced the full abrasive force of the ice mass. Glacial mass-wasting occurs particularly in the lee of the hills, through plucking and sliding of blocks enhanced by the highly developed joint sets and the presence of thin clay wayboards, to form the classic terraced topography. In much of the western Burren the karstification is relatively superficial, suggesting relatively recent, and rapid, stripping of the shale cover; much of this surface landscape is classic glaciokarst. Further east the karst clearly has a much longer history of development and might perhaps be described as 'glaciated karst'. Still further east on the Gort lowlands, large sections of, probably pre-Pleistocene, karst conduit continue to function as the main drainage for the area despite prolonged and repeated glaciation.

In the Sligo-Leitrim area spectacular U-shaped valleys are the most obvious manifestation of glacial erosion. Today their steep flanks are littered with vast landslipped limestone blocks; these are the key to understanding the glacial development of this landscape. The limestones here are underlain by mudstones, which are both mechanically weaker and susceptible to weathering. These weathered mudstones are readily eroded by glaciers, undermining the limestone above and causing landslips once the glacier has retreated. These landslipped blocks, shattered and disturbed by their journey valleyward, are then easily removed by the next glacial advance and so the process is repeated and the spectacular valley cross-sections are maintained.

In conclusion, the role of ice in moulding the limestone landscapes of Ireland has been very much subordinate to normal karst processes operating through the Tertiary and warmer periods of the Pleistocene. The influence of ice on these karst landscapes appears to have been indirect, associated with the stripping away contiguous clastics, but nonetheless the results form highly conspicuous elements of the present landscape of Ireland.

Ice and the Patagonian landscape

David Sugden, Department of Geography, University of Edinburgh, Edinburgh EH8 9XP

This paper uses empirical field studies and modelling to study the behaviour of the Patagonian ice cap. The ice cap developed in a similar latitude and climate to those glaciers that formed in Ireland during the last glaciation. Topography and climate interact in several ways to influence the mechanisms of glacier flow and erosional and depositional effects on the landscape. The main conclusions that may be of interest in an Irish context are that:

a) There are frequent glacier oscillations on millennial time scales that reflect changes in both temperatures and windfields.

b) The feedback between ice cap growth and climate leads to asynchronous glacier fluctuations in the lee of the ice cap.

c) Interaction between ice growth and the geometry of the topography leads to different patterns of glacier extent at stages of a glacial cycle when climatic conditions are the same.
d) landforms of glacial deposition have accreted during multiple advances and this accounts for complicated relationships between the age of landforms and the sediments involved.
e) Landforms of glacial erosion and deposition place topographic constraints on subsequent glacial behaviour.
f) The effect of deforming beds in encouraging low-gradient ice lobes has been overestimated.

Glacio-isostatic flexural modelling of the Galtee Mountains, County Tipperary and Comeragh Mountains, County Waterford: A glimpse of pre-Quaternary landscapes?
Sarah Taylor & Alex Densmore, Department of Geology, Trinity College Dublin

The Galtee and Comeragh Mountains lie in a zone believed not to have been engulfed by the ice sheets of the most recent Midlandian glacial. McCabe (1985) designated the summits of these mountains as unglaciated, and it is believed that they were nunataks during the Quaternary. The corrie basins, which cut into the northern flanks of Galtee, and around the Comeragh Plateau, do not appear to overtop the summits and form discrete features surrounded by gently rolling slopes discernibly unaffected by the periglacial corrie and valley glaciers.

In this paper the pre-Quaternary land surface is reconstructed from the pre-corrie (land surface outside the corries) and pre-Quaternary (nunatak) remnants in the present-day topography. Photographs and maps of the present-day and modelled pre-Quaternary land surfaces will be presented to illustrate the modifications the glacial activity wrought on the landscape. Estimates of the degree of erosion required to bring the modelled pre-Quaternary topography to the present-day land surface will be shown to illustrate the differences between the present and modelled land surfaces.

A commonly cited, but poorly constrained, hypothesis is that a significant fraction of present-day mountain-scale relief in southern Ireland is due to glacial erosion and subsequent isostatic unloading. Molnar & England (1990) suggested "relatively rapid erosion of highlands fuelled by climatic changes of the Quaternary would naturally be associated with high rebound rates due to accelerated erosional unloading of buoyant continental crust." The critical assumption is that, excluding the effects of removing the ice load, basins being fed by glaciers will receive more sediment than those being fed by streams. Hallet et al. (1996) substantiated this claim in their paper on rates of erosion and sediment evacuation by a glacier, which states, "on average, yields for basins extensively covered by glaciers (say >30% glacier cover) are about one order of magnitude higher than for glacier free basins."

The estimated erosion profiles and whole mountain eroded rock volumes will be used to predict isostatic and flexural uplift due to rock removal from the Galtee and Comeragh Mountains. It will be shown that Quaternary erosion cannot yield more than 15 meters of summit uplift, thus necessitating other mechanisms to explain the high elevations of these mountains. But that's another story!!

HALLET, B., HUNTER, l. & BOGEN. J., 1996. Global and Planetary Change, 12, 213-235.
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McCABE, A.M., 1985. In: Edwards et al. (ed) The Quaternary history of Ireland, 67-93.

Recent Publications on Quaternary Research in Ireland

Carr, S.J. and Meehan, R.T. "Glaciotectonised sediments at Mullaghmore, County Meath, Ireland: evidence of a large-scale readvance during ice sheet deglaciation?" Quaternary Newsletter, No. 95, October 2001, pp. 23-26.
Clark, C. D. and Meehan, R.T., 2001. "Subglacial bedform geomorphology of the Irish Ice Sheet reveals major configuration changes during growth and decay". Journal of Quaternary Science, Vol. 16, Issue 5, pp. 483-496.
Delaney, C.(2002) Esker formation and the nature of deglaciation: the Ballymahon Esker, Central Ireland. North West Geography, 1(2): 22-33 (www.art.man.ac.uk/Geog/mangeogsoc/nwgeog.htm)

Recent publications contd.

Dowling, L.A. and Coxon,P. 2001. Current understanding of Pleistocene temperate stages in Ireland. Quaternary Science Reviews. 20, 1631-1642.

McDermott, F., Mattey, D.P., Hawkesworth, C.J. (2001) Centennial-scale Holocene climate variability revealed by a high-resolution speleothem $\delta_{18}O$ record from S.W. Ireland. *Science*, **294**, 1328-1331.

O'Connell, M., Molloy, K., Holmes, J.A.,

Jones, R., Leuenberger, M., Eicher, U. Saarinen, T., Schettler, G., McDermott, F., van der Plicht, J., Chambers, F.M., Daniell, J.R.G., Hunt, J.B., van Geel, B., Haas, J.N. and Dalton, C. 2001. Evidence from the TIMECHS project for climatic instability during the early Holocene at the Atlantic fringe of Europe. *Terra Nostra*, **2001**, 159-161.

O'Connell, M., Molloy, K. and McMahon, H.

2001. Reconstructing prehistoric farming activity and human impact at a fine spatial resolution: palaeoecological investigations at Mooghaun, Co. Clare, western Ireland. In: Schauer, P. (ed.), *Beiträge zur Siedlungsarchäologie und zum Landschaftswandel. Regensburger Beiträge zur Prähistorischen Archäologie*, **7,** 161-186.

O'Connell, M. 2001. Neolithic impact in

Atlantic Europe: timing, intensity and environmental contexts. *Monsoon* **3,** 78-82. (Extended Abstract, ALDP Meeting, 'Environmental Changes and the Rise and Fall of Civilizations', International Research Center for Japanese Studies, Kyoto; Nov. 2001)

Richards, A.E. (2002) A multi-technique study of the glacial stratigraphy of Co. Clare and Co. Kerry, south-west Ireland. Journal of Quaternary Science 17, 2.

International Coastal Symposium 2002 Field Guide

Knight, J. (ed) 2002. Field Guide to the Coastal Environments of Northern Ireland. University of Ulster, Coleraine. ISBN 1-85923-158-6. 216pp.

The biennial meeting for the world's coastal scientists was hosted by the University of Ulster at Coleraine earlier this year. The field guide accompanying this meeting is now available for purchase. The guide outlines the geomorphic diversity and development of the Northern Ireland coast over the last 15,000 years. It is of interest to a wide range of professional and student users including geologists, geomorphologists, coastal planners and managers. It is also the only book of its kind on the Northern Ireland coast. **Copies of the field guide** (price £10 stg) can be obtained from: Dr Derek Jackson, Coastal Research Group, School of Biological and Environmental Sciences, UNIVERSITY OF ULSTER, Coleraine, BT52 1SA; E-mail d.jackson@ulst.ac.uk; Tel: (028) 7032 3083 (direct line)

MSc Thesis abstract

Palaeoecological changes during the Holocene on the Mizen Peninsula, southwest Ireland.

Scott Timpany (2001) Centre for Quaternary Science, Geography, School of Science and the Environment, Coventry University, Priory Street, Coventry, UK.

The Mizen Peninsula of southwest Ireland is rich in archaeology from the megalithic monuments dating back to the late Neolithic to the stone castles from the Medieval Period. Recent excavations around Mount Gabriel have led to the discovery of a number of known Bronze Age copper mines, now considered to be one of the main copper producing sites in Ireland. In order to place the prehistoric, Early Christian and Medieval archaeology of the area into an environmental context, this study looks at two new lowland peat bogs close to Mount Gabriel in order to reconstruct the vegetational history of the area through pollen, non-pollen microfossils (e.g. fungal spores) and microscopic charcoal.

The reconstructed palaeoecological record suggests humans have occupied the Mizen Peninsula since the Later Mesolithic with evidence of possible clearance activities taking place throughout prehistory and into the Medieval Period, with the main permanent clearances of the woodland occurring during the Bronze Age. Woodland clearance and cereal cultivation in the palaeoecological record coincide with periods of known megalith construction, copper mining and castle building, indicating that the Mizen Peninsula was an important location in Irish prehistory.

Annual General Meeting, 2002

Date: 23rd March
Venue: TCD

Apologies
Apologies were received from Susan Hegarty and Mike Simms.

The meeting began at 4.00pm, ended at 4.50pm, was attended by thirteen members and chaired by Pete Coxon. Pete Coxon signed the minutes of the 2001 AGM as being an accurate record of the meeting.

Chairpersons' Business
The chairperson Pete Coxon outlined the years activities in IQUA over the previous year. A field meeting was organised to Connemara 12-14th October and was well attended. Contributors to the meeting included Alan Lees, Louise Hildebrand, Michael O Connell, Pete Coxon, Catherine Dalton and Michael Gibbons. Because of F&MD it was deemed too late to put together an adequate field guide. In its absence a small guide was put together and put on the IQUA Website.

The Annual Symposium addressed the theme of Ice in the Irish Landscape, GSI 23rd November 2001. The symposium was organised by Mike Simms. The symposium was well supported with c. 45 in attendance. The meeting was followed by the unveiling of a plaque to Frank Mitchell by Bill Watts at Trinity College.

The Chair outlined IQUA's intention to start the process of putting together a book on the Quaternary History of Ireland on a similar scale to the Geological History of Ireland and Britain. It is intended to be a multi-topic, multi-authored illustrated review of Irish Quaternary Science by experts in the field. Favourable reaction has been received from two publishers. Potential authors have not been approached yet.

Items of Correspondence
One item of correspondence was received to point out a clash between the IQUA AGM and a meeting of the Association of Environmental Archaeologists. It was suggested that the committee revisit its institutional links.

Treasurer's Report
The audit for the year is complete. IQUA funds remain in a healthy state. Major expenses include the annual symposium and insurance. Unpaid subscriptions (corporate and private) and the absence of a field guide for 2001 helped depress the potential balance. It was suggested that a direct debit form be organised to encourage members to maintain consistent subscriptions.

Secretary's Report
There was no secretary's report.

It was suggested that the most important item was updating the Web page. It was also suggested that the roles of secretary and web page co-ordinator be separated. Steve McCarron has agreed to discuss division of these roles with Susan Hegarty.

Annual Field Meeting
At a previous committee meeting a list of possible field-trip venues was compiled. Susan Hegarty agreed to organise a trip to Kilkenny. Pete Coxon to discuss annual field meeting with Susan Hegarty. Cathy Delaney suggested that a co-organiser for each meeting be appointed, Pete agreed to raise this with Susan. A fall-back option location 'The Sperrins' was also discussed to be organised by Steve McCarron. Steve to discuss with Susan Hegarty.

Annual Symposium
The theme for the symposium this year will be 'Multi-proxy methodologies for reconstruction' (working title).

Suggested topics include current Irish methodologies, chronological methodologies (cosmogenic dating, ground penetrating radar) and offshore cores. The symposium is planned for late November (date to be confirmed).

Date of next meeting
The next AGM is planned for the end of March 2003. A committee meeting is planned for early May 2002.

Any other Business
The QRA field-trip to Kerry has been reconvened for May 2001, however key speakers have not received any official communication of this change of date. The Chairperson is to contact QRA for clarification.

Michael Philcox is to circulate the IQUA constitution to committee members to ensure correct practice.

Catherine Dalton

IQUA wishes to acknowledge the support of our Corporate and Institutional members:

John A. Wood Ltd., Roadstone Dublin Ltd., Geological Survey of Ireland, Environmental Protection Agency, Roscommon County Library, Bergakademie, Freiberg, Germany, EX LIBRIS, Frankfurt, Germany, Natural History Museum, London.

Contributions for the next IQUA Newsletter should be sent to:

Dr Janice Fuller, Department of Botany, NUI, Galway
