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EDITORIAL

The ES2k Magazine is back again – with a new name, Earth Science Ireland. It is still free of charge, thanks to our sponsors. I will try to present interesting and colourful articles, some easy-reading and others that will be intellectually more challenging. The first issue concentrates a little on the Mountains of Mourne – because it is a proposed National Park that has our full support. Exciting things are happening at the two national surveys and at our universities – I include reports on some of them. Future issues will bring you the best of Ireland’s Earth science – conservation, research, education, industry and tourism. The aim is to visit, in words and pictures, every corner of our wonderful island.

Let us know if you think we are succeeding – most of your letters will be published, here or on the website. I love hearing from readers – the praise and the criticism but especially ideas for new topics – what is important for you?

Can I say we are back by popular demand? We are - please enjoy this new start.

You will find the logos of our main sponsors on the front cover of the magazine. They are acknowledged on this page with other sponsors, including amateur groups. All are cherished and if you are involved with an organisation that would like to contribute please let me know. Want to advertise? Just contact me.

Contributions, please, for the next issue to the Editor or the Provincial Correspondents – for Connaught Martin Feely, Department of Earth & Ocean Sciences, NUI Galway martin.feely@nuigalway.ie - for Leinster Matthew Parkes, National Museum of Ireland, Merrion Street, Dublin 2 mparkes@museum.ie - for Munster Bettie Higgs, Department of Geology, NUI Cork b.higgs@ucc.ie - for Ulster Alistair Ruffell, School of Geography, The Queen’s University of Belfast, Belfast BT7 1NN a.ruffell@qub.ac.uk. Thank you to contributors in this issue.

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BE A CAREFUL CORER

A problem highlighted in the most recent issue of Earth Heritage by Colin MacFadyen of Scottish Natural Heritage (Earth Heritage 27,12) has unfortunately taken the short crossing from Scotland and landed in Co. Antrim. The thoughtless action of someone coring basalt samples, presumably for palaeomagnetic or geochemical studies, has left a permanent and highly visible scar. Black Head is a very picturesque basalt headland and popular coastal walk, east of Whitehead, near Carrickfergus. Having read Colin’s article the previous week, I was astonished to see the curse of the corer right on my own doorstep.

So what’s the problem I hear you ask? Well I believe there are a number of issues. I accept the need for sampling and would not stand in the way of legitimate research. Our geological sites provide an invaluable natural laboratory for studying our earth’s history. Indeed, selection of Northern Ireland’s Earth Science Conservation Review series was informed, at least in part, by a site’s future research potential.

Visual considerations are to the fore at Black Head. The choice of coring location is right beside the path on a very prominent rock face. Alternatives included choosing a less obvious section, particularly where the flow series forms the inter-tidal area – coring here would have had no lasting visual effect. If sampling options are limited then plug the hole up after sampling with the outer section of core. In addition, the coring site immediately adjoins one of the best sections displaying the vesicles cylinders for which the site is well known.

Carried to its extreme, coring can go beyond merely visual impacts; it can effectively result in destruction of a site's scientific value where key components are of limited extent.

The Geologists’ Association has produced a guide to responsible coring. Titled the Code of Conduct for Rock Coring this recommends that

- Core sites should be discrete and taken from the least exposed faces;
- The minimum number of cores should be taken; and
- Holes should be plugged or refilled using local matching material.

We all frown at graffiti on rock faces or other forms of senseless vandalism; let us please ensure that geologists do not impact on the visual value and setting of our geological heritage.

Black Head is not an Area of Special Scientific Importance. If it were

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Black Head is not an Area of Special Scientific Importance. If it were then a consent system would operate for research and other scheduled activities. This is to ensure that designated sites are managed and used appropriately and sustainably. A future issue will carry more information on geologists’ legal requirements and responsibilities when planning to work within these designated sites.

Ian Enlander
Environment and Heritage Service
ARSENIC POISONING KILLED THE DINOSAURS?

The Cretaceous/Tertiary Boundary (K/T boundary) in the north of Ireland is above the white Cretaceous chalk and below the black Tertiary basalt lava. It is exposed all around the Antrim Plateau. As good a place as any to see it is in the car park for Belfast Zoo.

This is when the dinosaurs, large marine reptiles, the ammonites and many other animal groups became extinct.

There are several theories to explain why life went into major crisis at the K/T boundary. The strongest contenders are either an asteroid smashing into the Gulf of Mexico (Chicxulub) near the tip of the Yucatan Peninsula or the eruption of the basalt lavas of the Deccan Traps that are up to 2 kilometres thick in India. Both events took place about 65 million years ago. Both could have thrown dust and gases high into the atmosphere, causing temporary climate change and poisonous air/water conditions.

Now we read that the Austrian geopark Eisenwurzen is proposing arsenic played its part! There the K/T boundary is marked by a dark clayey layer just 2cm thick. Scientists from the Russian Academy of Sciences and the Vienna Natural History Museum have found that the lower part of the layer contains particles of gold, copper, titanomagnetite, iridium, lead, zinc, arsenic and chromium which indicate an origin from the Deccan volcanic eruptions.

The mineral composition of the top part of the boundary layer is totally different. The iridium content has strongly decreased. The sediment contains spherules of nickel, of an iron-nickel alloy and also tiny crystals of diamond. It suggests the impact of an asteroid or meteorite between 500 and 800 years after the main peak of the volcanic activity.

So in Austria both a volcanic and a slightly later extraterrestrial event took place at the K/T boundary. It is further evident that iridium, which has generally been considered as proof of an extraterrestrial strike, is mostly of volcanic origin.

The Austrian Geopark appears to establish a direct connection between the events at the K/T boundary and the extinction of life. The rocks were deposited in a deep sea and contain small shells of foraminifera. Some species were already extinct before the K/T boundary. With the release of arsenic and heavy minerals like lead and zinc into the atmosphere, the number of species decreased to zero. Clearly, the poisoning of the atmosphere some 65 million years ago was not only lethal for many marine life forms; it was the final deathblow for the dinosaurs. In contrast to the opinion of most scientists, the asteroid impact, which took place a few hundred years later, had little effect on life on Earth.

So, where does the Antrim Clay-with-Flints fit into the picture? The volcanic dust has been determined to be acidic, not basic as it would be if it came from the Deccan explosions. Even so, we have cataclysmic explosions and major eruptions of basalt lava – approaching Deccan Trap proportions. A double whammy for animals that survived the Deccan eruptions and the Chicxulub asteroid! Further detailed analytical work on the Antrim clay-with-flints might yield interesting results.

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Tony Bazley
(with thanks to Heinz Kollmann of the Vienna Natural History Museum)

Earth Science Ireland Magazine
CALL FOR PHOTOGRAPHS

Aspiring photographers should keep in mind the annual Du Noyer geological photographic competition run by the Geological Survey of Ireland in association with the Irish Geological Association. This year will be its ninth year in existence and it gets better literally every single year. We show just two of the many entries from last year – a rock ‘face’ in Sligo taken by John Linehan and limestone grykes in Clare by Con O’Rourke.

The competition had a prize fund of €600 last year and accepts photographs of geological interest taken either in Ireland or abroad. So on the field trips or holidays this summer take your camera and if you get a shot you are proud of just send it in.

Closing date for this year’s competition is Friday 16th November and entry details will be available at www.gsi.ie closer to the time.

Keeping a geological eye on the proposed Mourne National Park

With the consultation process on the Mourne National Park in full swing in the latter part of 2006, a number of us got together and formed a ‘Mourne Geology and Archaeology Group’ (MGAG). We all have a keen interest in the geology, archaeology and upland industrial heritage of the Mournes and include ex-students and staff of Queens University Belfast Geology Department and others from Trinity College Dublin, University of Ulster, University of Birmingham and even the University of Farmington, Maine, USA.

The main aim of the MGAG is to significantly raise the profile of geology and the upland industrial heritage and archaeology in the Mourne Mountains and Mourne Area of Outstanding Natural Beauty (AONB). Our initiative is targeted at the Mourne National Park Working Party, key stakeholders in the AONB and the public in general as the region progresses towards National Park designation.

We have already made a number of presentations of our geological work in the Mournes, culminating in January in a response to the Mourne National Park Working Party public consultation. This document can be found on our web site www.mgag.eu and amongst other things expresses concern at the lack of emphasis being placed on the classic geology and upland industrial heritage in the Mournes. The Mourne National Park working party’s web site is at www.mourneworkingparty.org where maps and reports on the proposed National Park can be found. The Mourne Heritage Trust’s very informative site about the Mourne AONB is at www.mournelive.com/.

We will welcome reader’s support for our aims and initiative. Please contact David Hood by email at david.n.hood@btinternet.com.

Dave Hood

(I know many ES2k members responded to the Mourne National Park Working Party consultation. ES2k in general supports the National Park proposal and will also be watching progress – Editor)
The emplacement of the Eastern Mourne Granite: continuing the debate nearly 80 years on...

Carl Stevenson (Birmingham University) reports on new research in the Mountains of Mourne, Co Down

Granitic magma flowed into place in the Mourne area around 56 million years ago (Ma) at what was then a depth of roughly 3-5 km and before the Atlantic Ocean existed. A combination of geological uplift and glaciation has exposed and shaped the granite of the Mourne Mountains. The question this article deals with is how space was made in the much older Silurian-aged (between 440 and 420 Ma) sedimentary country rocks to accommodate this magma and how this magma flowed into place – the emplacement of the Mourne Granites.

From the work of J.E. Richey, the Mourne Granites were the first example of the cauldron subsidence granite emplacement mechanism. In this mechanism, a large block of country rock (roughly circular with a flat top) subsided passively (or sunk) into a larger subjacent magma chamber. Initially, magma flowed up the annular space between the subsiding block and the unmoved country rocks forming a steeply dipping arcuate or partially circular ring-dyke. As the block founders into the magma chamber the vacated space is filled by upwelling magma, resulting in a passively emplaced crosscutting (discordant) pluton. This model is extremely important and has subsequently been invoked to explain the emplacement of similar granite plutons all over the world, including Nigeria, Norway, the Andes, N. America, Mexico, Greenland and more.

Richey divided the Mournes into Eastern and Western Centres with four different granite types; G1, G2 and G3 in the Eastern Centre and G4 in the Western Centre. His model was based on the description of the geometry of the granite boundaries (contacts) where he showed gently dipping ‘roof’ contacts and steeply dipping ‘wall’ contacts. The main evidence for this was that the earliest granite type to be emplaced (G1) caps Slieve Donard and Commedagh, representing the roof situation. The same granite also occupies a swath along the eastern margin (along the Kilkeel Road) and a smaller outcrop in the NW underlying the Tracy River, Polphaluca and Slieve Meelmore both representing the wall situation. This geometry, Richey contended, was reflected in all the other types of Mourne Granite.

G.P.L. Walker suggested an alternative possibility in 1975, which was that the Mourne Granites were emplaced as a lateral sheet (the ‘curved flange’ model) emanating from the southwest. This was still a passive emplacement model, but never really taken as seriously by the scientific community as Richey’s cauldron subsidence model. Then, in the 1970s and 80s, researchers at Queen’s University Belfast, Ian Meighan, David Gibson and David Hood, divided Richey’s original units into smaller units but more significantly showed that the G1 granite in the wall situation was actually closer in composition to G2 (the next oldest granite) - see David Gibson’s and David Hood’s map in the OSNI 1:25 000 Mournes Map. This severely undermined Richey’s model showing that the simple roof and wall geometry did not exist as he had thought. However, without any information on how the magma actually flowed into place or how space was created, the original model stood.

If Richey’s cauldron subsidence actually occurred, there should be evidence of steep magma flow up the eastern side and then lateral flow from east to west across the top. However, magma flow is extremely difficult to detect in granite. Such a viscous magma
(imagine rice pudding) does not easily preserve the flow alignment of minerals. A recently published paper (Stevenson et al. 2007 – see below), on the Eastern Mourne Granite, utilised a technique that measures the anisotropy of magnetic susceptibility (AMS) of an oriented rock sample. This effectively detects very weak preferred long axes alignments of iron bearing minerals (biotite and magnetite). Using this technique very weak mineral alignments (fabrics) can be measured that would be too subtle to measure in the field using the naked eye.

The AMS data revealed a hitherto undetected fabric in the Eastern Mourne Granite. This fabric was however, gently dipping right out to the margins – the steeply dipping fabrics expected from Richey’s model were absent. This makes Walker’s model much more likely, especially as the linear component of the AMS fabric was oriented SSW – NNE diverging northwestwardly suggesting that magma flowed in from the SSW. The next question then, is how the fabric in the granite relates to the structure of the host rocks. If the emplacement was indeed passive, the host rock fabrics (mainly sedimentary bedding) will be completely crosscut by the granite. It was found, however, that the sedimentary bedding is bent into parallelism with the granite around the northeast, east and southeast. This suggests that the emplacement was forceful, i.e. the granite magma pushed country rock aside and up to make space for itself. Evidence of faulting along the eastern margin was also found; the sense (direction of fault movement) indicated that the roof had been forced up like a flap. The emplacement of Mourne Granite thus involved the initial emplacement of a thin sheet, emanating from the SSW that subsequently thickened vertically, pushing up its roof, as more granite was emplaced. This is known as a laccolith, the best examples of this type of emplacement are found in the Henry Mountains, Utah, USA.

So the emplacement of the Mourne Granites was forceful, a highly significant finding for the principal example of an important passive emplacement mechanism. This finding also has significant implications for the study of granite plutons beneath volcanoes, usually assumed to be emplaced by cauldron subsidence sometimes referred to as the ‘plutonic-volcanic subsidence system’. These bodies represent the magma chamber from which the volcano erupts and the pathways of magma ascent to the volcanic edifice. The ‘plumbing’ of subvolcanic plutons is crucial to understanding how and when volcanoes erupt.

This classic piece of Irish geology still challenges scientists and may hold the answers to long-standing geological problems. 80 years after Richey described an emplacement mechanism that would be applied to plutons around the world, the debate continues...

REMARKABLE MEETING OF MINDS
50th Annual Geological Research Meeting – ES2k Editor reports

Hard to believe. Now been going for 50 years, an informal weekend event that each year is organised by a different university or research organisation. Dublin, Cork, Belfast, Galway, Sligo and the list could go on. This year, 2007, the host was the School of Environmental Sciences, University of Ulster, Coleraine. The meeting was as successful as ever in spite of what some would call an old-fashioned format. Thanks and plaudits especially to Rachel Cassidy with Sandy Steacy and the Department of Environmental Sciences team. Congratulations also to the winners of the Best Student Talk and Poster prizes, going to Marco Patacci and Lucy Baudouy respectively, both from UCD.

There is an impact by the major projects being run by the two geological surveys, the offshore programme of the Geological Survey of Ireland (GSI) and the Tellus Project (regional geochemistry and geophysics) of the Geological Survey of Northern Ireland (GSNI). The data collected are already spawning research projects in the universities.

A dozen talks addressed results from offshore Ireland. Work on the Porcupine Basin is particularly active, from the study of fluid inclusions that bear hydrocarbons by University College Galway (UCG) to seismic studies using airguns that bounce sound waves off rock surfaces in the crust to give new regional pictures of deep structures - by the Dublin Institute of Advanced Studies (DIAS) and University College Dublin (UCD). The same group reported on their HADES project tackling problems in the Hatton Basin and there was seismic data from 450km out to sea at the Rockall Plateau explained by Trinity College Dublin (TCD) scientists. UCD workers reported on Permo-Triassic basins and on the provenance of Mesozoic sandstones in the Corrib Gasfield area whilst others from TCD estimated past erosion rates in the rocks of the Slyne Basin. Adding to attractive presentations were the underwater photographs of cold-water corals on carbonate mounds reported from the IODP (International Ocean Drilling Project) by UCC, GSI, the UK National Oceanographic Centre, Southampton and the Dutch Institute of Sea Research. Perhaps rather worrying if you are interested in marine life because large areas of the Porcupine Bank have obviously been seriously damaged by trawling activities.

Back on land Queens University Belfast (QUB), GSNI and the University of Alberta, Canada are applying new statistical techniques to improve the resolution of results from the Tellus Project. QUB also have an active programme relating geology to crime – namely soil fingerprinting and other techniques to help forensic scientists to link soil left at scenes of crime on car wheels, shoes etc to the culprits.

A University College Cork (UCC) worker suggested that rock deformation at the famous locality of Hook Head, Co Wexford might be contemporaneous with earthquake activity in South Wales. Going north, a geopark geologist told us that the Marble Arch Caves Geopark is being expanded into County Cavan to make the world’s first trans-national Geopark – a really exciting development for the local economy of the region. Another cave system, at the other end of the country and this time double-tiered, has been mapped using electrical resistivity surveying near Cloyne in County Cork by UCC.

DIAS are making a major study of the crustal structure in SW Ireland using seismic methods in conjunction with German collaborators. The same group, with UCC, described an interesting project in County Offaly in the grounds of Birr Castle, which in the 1800’s held the world’s largest telescope. Astronomers want a modern radio telescope here and a resistivity survey has been used to prove foundation conditions, particularly the depth of superficial deposits to bedrock.

Anomalous dates using white mica from the Upper Devonian sandstones of the Munster Basin were explained (UCC and Potsdam, Germany, collaborating). UCG workers are collaborating with the National Isotope Centre in New Zealand on studies of fluid inclusions and stable
isotopes in relation to mineralisation in the Rosses Granite Complex, County Donegal. TCD and Manchester University, England are studying the Shankill Fracture Zone in – don’t worry Belfast, it’s not your Shankill – the Leinster Basin Batholith. It shows rare evidence of relatively recent, Miocene, movement. TCD have also, with Durham University this time, dated Carboniferous organic-rich shales from the Clare Basin to 313 million years (+ or – 23) using the new Re and Os isotope method – test for readers “What are these elements?”

Irish fossils did not feature much at the conference. A UCC scientist described new rugose corals from the Lower Carboniferous of the Howth peninsula, County Dublin. Two groups, from the Ulster Museum (UM) and TCD, have been working on the Triassic/ Jurassic boundary where it is exposed near Larne in County Antrim. This is the zone of one of the five major extinction events and the UM group claims it is the best such exposure in NW Europe. Perhaps the most advanced research was on exceptionally preserved shrimps over 200 million years old (Triassic) from Frome in Somerset, England. Muscles, digestive organs, nervous tissues can all be seen! UCD is working on the shrimps with Bristol University and French collaborators.

Studies of the last Ice Age hold the promise of better understanding of the triggers that cause climate change – before there was the potentially devastating impact of Humankind. Ulster University workers are now at the sharp end of such research and presented a reconstruction of the last ice sheet off the NW coast of Ireland. UCD and TCD reported on thermohaline currents off the west coast of Ireland and the implications for climate change. UCG described glaciation near Castlebar, Co Mayo and UCD/Maynouth looked at the Quaternary deposits in the Tuliamore region of Co Offaly.

A third of all presentations were about research being carried out overseas, including just one in Scotland. UCD, TCD, UCG and Ulster University were those mostly involved and DIAS are working on a database called TOPO-Europe, which monitors the changing earth we live on. These projects excitingly involve many overseas collaborators showing acceptance of the international quality of Irish scientists. Topics included earth movements and sedimentation in SE Spain, earthquake studies in the Gulf of Corinth and the Marmara region of Turkey and predictive work in relation to tsunamis in Indonesia. The latter is an area of research where the UU Coleraine is now a leading player on the world stage.

Volcano ‘watchers’, trying to understand what is happening in the molten vents and so predict future eruptions, are busy. Reports were heard from workers on Etna, El Hiero, Canary Islands where giant landslides have been triggered, and Teide Volcano, Tenerife.

Eocene fish from SW Wyoming, USA, Moroccan Dinosaurs, and Spanish Miocene tadpoles made a fascinating mix for those interested in past life on Earth. Studies of 14C and oxygen isotope data from stalagmites in caves in SE France and Attahöhle Germany are being compared with new results from the Central Alps to tell us about solar irradiance and climate change in the past.

Talking rocks from space was a senior TCD worker who described the make-up and age of basaltic meteorites that came from asteroid 4 Vesta. The meteorite that landed in Bovedy, Co Londonderry in April 1969 was featured amongst spectacular photographs.

David Martill of Portsmouth University and Tavi Murray of Swansea University gave Guest Lectures. The former described the last of the giant pterosaurs, flying reptiles of the Mesozoic Era with wings spans of up to 14 metres; he suggested airframe engineers and material scientists could do well to study these creatures. Professor Murray outlined geophysical success stories in understanding ice stream dynamics in the Antarctic. Understanding what controls ice motion kilometres beneath the surface will be significant in appreciating why there is shrinking or advance of ice at the margins, much in the news these days.

This summary of the meeting gives just an indication the breadth of research currently being undertaken. It is all exciting, some of it internationally important, and much of it of practical and economic significance. All of it is improving our understanding of the Earth and past life. It is giving a guide to future changes that might affect our own way of life in Ireland. What was not mentioned? There is plenty more going on, minerals, quarrying, and building…. Earth Science Ireland looks forward to reporting on them all.
A MILLION YEARS OF THE IRISH BOG

What can Irish bogs tell us about past and future climate change? David Large, University of Nottingham is looking for answers.

Sitting in the path of mild air and Atlantic storms, few things are more distinctive of the rain drenched Irish landscape than the bog. Don’t we all know it! From the highest hills to the lowest depressions the land is frequently covered in a layer of wet peaty soil a few centimetres to several metres thick. Recent Irish bogs are part of a swathe of northern hemisphere temperate and sub arctic bogs that formed during the past ten thousand years. They contain in their peat a detailed record of climate change since the end of the last ice age. These bogs not only provide evidence of past climates but they may also influence future climate change. Across the boreal region, 1/3 of Earth’s soil carbon is stored in water-saturated peat. But as Earth’s climate warms the future of this vast carbon store looks bleak. Global warming is melting the frozen peat of the permafrost releasing stored methane, a powerful greenhouse gas. Lack of water may lead to oxidation, burning and the release of carbon dioxide from peatland. But is this really the future of the bog? How will our bogs behave in the next thousand or million years? Let’s consider some older peat deposits.

The greatest period of Irish bog formation was thirty million years ago, during the Oligocene, when vast peat deposits accumulated in the vicinity of Lough Neagh and Ballymoney. The peat has become compressed through time and is now termed lignite or brown coal (being half way towards becoming coal). The lignite is 105 m thick at Ballymoney, one of the thickest lignite deposits in the world. The peat to make this much lignite would have been about 875 m thick, a pile of peat almost as tall as Ireland’s highest mountains if it hadn’t been compacting even as it was forming. These lignite deposits should help us to understand bog evolution over very long periods of time but first we need to measure how long they took to accumulate.

The lignite is too old to use carbon –14 for dating as we would for modern peat. We need to look for more subtle evidence of changes caused by variations in the Earth’s orbit around the Sun.

As the Earth orbits the Sun its orbit changes slightly and periodically with distinct oscillations occurring every twenty thousand, forty thousand, one hundred thousand and four hundred thousand years. These slight changes or cycles in the Earth’s orbit affect the amount of energy we receive from the sun, which in turn affects our climate and produces a distinct pattern of environmental change in the geological record. For example orbital cycles in solar energy were sufficient to pace the ice ages. To identify orbital cycles geologists must first produce a record of continuous environmental change. In the Ballymoney lignite the environmental indicator used was the ratio of two carbon isotopes, carbon-12 and carbon-13. Taken up by plants during photosynthesis, these carbon isotopes record changes in the composition of the atmosphere and the influence of environmental stress on plants. Carbon isotope measurements of the Ballymoney lignite were made on samples collected every 15cm over a total interval of 50 m. Next, the carbon isotope record was examined and a distinctive orbital pattern identified. This pattern was then used to convert depth to time. By identifying orbital cycles in the Ballymoney lignite we now know that 50 metres of the Ballymoney lignite formed over a period of approximately 1.16 million years – or the full 105 metres about 2¼ million years.

This measure of time now lets us estimate rates of carbon accumulation, rates of climate and vegetation change, and we can examine the simultaneous response of the terrestrial and marine environments to global climate change. In particular the estimated rate of carbon accumulation in the Ballymoney bog is similar to rates found across the boreal region today. This is fascinating, as although Ireland was in a similar geographic position as now, we know that the Oligocene climate was much warmer and atmospheric carbon dioxide concentrations possibly twice those observed today. Fossil plant remains in the lignite indicate that the Oligocene Ballymoney bog was dominated by trees related to present day sequoias (redwoods) and swamp cypress, very different to the moss covered bogs of today, yet it appears to have accumulated at a similar rate under a warmer more carbon dioxide rich atmosphere. It suggests that boreal peatland can thrive under higher concentrations of atmospheric carbon dioxide and a warmer climate. The nature of the bog may change but given the right setting it can continue to grow and accumulate carbon maybe for the next million years. So as we try to reduce atmospheric carbon dioxide we should view bogs as viable long-term carbon stores that, given the chance, can continue to accumulate and store carbon well into the future.

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Earth Science Ireland Magazine
In the graveyard of Holy Trinity Church in the Church of Ireland parish of Castlemacadam, beside Avoca, close to the celebrated copper mines, is a large block of Leinster Granite supported on some lesser stones. At first you could be excused for thinking that it serves no purpose but in fact it was placed there to mark the grave of the geologist George Henry Kinahan and that of his wife. He was a larger-than-life character who was gruff, combatant, and most-probably highly opinionated, but nevertheless had the common touch. He was greatly loved by many in rural Ireland whom he met while mapping, and especially by the miners who laboured under difficult conditions in the Avoca district. They affectionately knew him as the ‘the big miner’ and they carried his coffin at his funeral. Kinahan was born in Dublin on 19th December 1829 the son of a barrister and died at Woodlands, Dublin on 5th December 1908. Educated at Trinity College, Dublin, he read Engineering. Following graduation he was immediately employed to work on the Drogheda Viaduct, an impressive railway bridge that spans the river Boyne on the railway line connecting Dublin and Belfast. He then entered the service of the Geological Survey of Ireland (GSI) in 1854. By the time of his retirement he had risen through the ranks to District Surveyor, the second-most senior member after the Director. His brother John Robert Kinahan (1828-1863) was a medical doctor who had his own geological interests and wrote extensively on Irish Cambrian trace fossils.

Their sister Katherine was to marry Hugh Leonard in 1876 and he, like George, was an officer with the GSI. However he had a shorter career and had to retire in 1881. In 1855 Kinahan married Harriette Anne Gerrard. They had a son Gerrard who became a geologist, but a poisoned arrow killed him in 1888 in West Africa while mineral prospecting. She was a good artist whose drawings her husband often used to illustrate his publications.

Within the GSI Kinahan was noted for his endless energy and enthusiasm to explore even the most difficult of terrains. Equally he was renowned for his acerbic manner and fiery temper and he thought nothing of letting his colleagues know what he thought of them and their work. This led him into direct and open conflict particularly with Edward Hull, the Director of the Survey, who frequently threatened his underling with dismissal. For many years Hull had the sense to always ensure that he had a third person present whenever he met with Kinahan - for both men working under such circumstances must have been difficult. Nevertheless, they were productive times. All told he mapped approximately one-eighth of the area of Ireland and authored or co-authored twenty-six memoirs and thirty-eight maps. Kinahan was President of the Royal Geological Society of Ireland 1880-1881, a Member of the Royal Irish Academy, and an Honorary Member of the Manchester Geological Society and of the Institution of Mining Engineers.

He was a prolific author who wrote on a wide variety of geological, archaeological and natural history topics. He penned a series of papers on Irish folklore in the 1880s. To the Geological Magazine alone he contributed 85 papers. He made major contributions to the understanding of the complex geology of western Ireland, wrote on Irish glacial deposits, the Precambrian of Canada (which he visited in 1884) and the estuary of the River Slaney - to highlight just four topics. He authored seven books; his Manual of the Geology of Ireland was published in London in 1878 at the same time as Hull’s Physical Geology and Geography of Ireland with which it competed for sales and readership! With Alexander McHenry, a Survey colleague, he published a handy volume on reclaiming bogland, land flooded by the sea and other wastelands. However, for me and others interested in urban geology and building stones, Kinahan’s multi-part Economic Geology of Ireland (1885-1889) remains the most useful reference work to the stone, slate and clay resources of Ireland. All told Kinahan was a fine field geologist who assembled an encyclopaedic knowledge of Ireland’s geological history.

Next time you are driving through Avoca, take a few minutes to stop at Holy Trinity, Castlemacadam and locate the Kinahans’ grave. There under a granite boulder, on which the craved inscription is hardly legible, lies one of the giants of nineteenth century geology in Ireland.

Further reading: More details of the Kinahan-Hull feud many be found in Gordon Herries Davies’ history of the GSI North from the Hook. A splendid photograph of Kinahan and his wife appears on page 74.

Patrick N. Wyse Jackson
Trinity College, Dublin
WATCH OUT SCIENCE TEACHERS – ESTA’S COMING

JOIN US IF YOU CAN

ESTA is successfully helping advance education by encouraging and supporting the teaching of Earth science at all levels, whether as a single subject such as Geology, or as part of Science or Geography or other courses. There is a range of resources available online. This year ESTA has been invited by ES2k to hold its annual conference in Belfast.

Stranmillis University College 14-16 September 2007

Come for the whole time or just the INSET DAY on Friday 14th September (cost £30). We hope teachers from all over Ireland will take advantage of this opportunity.

The conference includes lectures, practical workshops, displays and field excursions. INSET Day is presented by members of the Earth Science Teachers’ Association and local experts. We will investigate some of the current ideas in Earth science and discuss changes in the curriculum. The need for greater awareness in relation to sustainability and the value of Earth science to schools will be examined.

Key Stage 3/4 ‘Teaching the Dynamic Earth’; Post-16 ‘Teaching for the Future’.


For more details see the website www.esta-uk.org or contact Karen Parks, Methodist College, 1 Malone Road, Belfast BT9 6BY kpmax80@hotmail.com.

GET DETAILS, PUT IT IN YOUR DIARY NOW. IT WILL BE WELL WORTHWHILE – AND FUN

What’s new in the Copper Coast Geopark?

The information point was temporarily relocated last summer in Annestown for a better access from the coastal road. The Geopark opened a bistro in the new premises and has been running numerous workshops and classes since. The landscaping of Tankardstown was also completed. Interpretation panels about the local geology, the mining heritage and numerous features within the Geopark will be installed this spring. The Geopark will take part in Bealtaine Festival of Outdoor Science (8-11th May) and European Geoparks Week (27th May – 5th June) with geology field trips and panning for “gold”. The summer programme with tours by local guides and children’s activities is under preparation and more information and updates can be found on our website: www.coppercoastgeopark.com

Copper Coast Geopark
Information & bistro
Seaview Celtic, Annestown, Co. Waterford
T: +353(0)51 396 686
E. info@coppercoastgeopark.com

PLEASE VISIT US IF YOU LIVE NEARBY OR ARE COMING THIS WAY

www.Planet Earth.ie
Look it up

The UN General Assembly has proclaimed the year 2008 as the International Year of Planet Earth (IYPE). The aim of the International Year of Planet Earth is to demonstrate new and exciting ways in which Earth sciences can help future generations meet the challenges involved in ensuring a safer and more prosperous world.

The Geological Survey of Ireland (GSI), with the support of the Royal Irish Academy, has established a National Committee for IYPE that is broadly representative of Geoscience in Ireland. This committee will facilitate the Irish contribution to the IYPE on an all-island basis. IYPE activities will be spread right across the island with local groups everywhere planning events right on your own doorstep.

By the time you read this the programme will be at an advanced stage of planning. There is still time, however, for you or your organisation to be involved. Just contact the GSI with ideas or offers to help. Also watch for the final programme on the website and make a resolution to come to events.

SPREAD THE WORD
“Geoscience underpins society more than ever”

New National Geoscience Programme (2007-2013) and Research Awards Scheme announced

“Geoscience underpins our society today more than ever” that was the message that rang out loud and clear at the launch last month in Dublin of the “National Geoscience Programme (2007-2013)” by Noel Dempsey, Minister for Communications, Marine and Natural Resources. It represents a further illustration of the ongoing commitment to world-class science of both governments on this island, for this is a truly cross-border initiative in its scope.

The wide-ranging programme, published as an attractive booklet, provides clear evidence of the importance of geoscience in our daily lives. Indeed the focus of the programme is on putting “our knowledge of the earth to work for Ireland”, the “our” referring to the co-publishers of the strategy – the Geological Survey of Ireland (GSI) and the Royal Irish Academy (RIA), in consultation with the geoscience sector across the island. That knowledge of the earth encompasses almost every aspect of society today. The houses that we live in are built from materials mostly found naturally in our earth. The oil that literally fires our lives is sourced through the expertise of geo-scientists. The water we drink is made safer by the monitoring work carried out by geoscientists. The infrastructure that makes life more convenient for us is made possible by the use of aggregates and other earth materials. Ireland’s scenic landscapes, so admired by countless locals and visitors alike, are the product of earth forces over millions of years and even the jewellery we wear often occurs naturally in the rocks around us.

Announcing a €33m investment over seven years, the Minister staunchly asserted the importance of geoscience within the government’s overall Science Strategy. He remarked that the programme had been crafted so as to “enhance many aspects of Irish life, including the sustainable management of our environment, the development of our natural resources and infrastructure, and understanding and predicting natural hazards.”

Noting that 2008 has been designated by the UN as International Year of Planet Earth, the geoscience sector was challenged to take this opportunity to herald its importance to the wider public.

The booklet is a fine, readable account of how geoscience “powers the economic engine.” Geoscience-based industry contributes more than €2 billion each year to the Irish economy. This figure is comprised of mining operations, aggregates, plasterboards and other materials for the construction industry, gas production and various high-level consultancy services, mostly carried out by highly skilled graduates of Irish science universities.

Recognising the essential ingredient of research within the successful implementation of the programme the Minister announced a major new initiative, the Griffith Geoscience Research Awards Scheme. The scheme, worth €3m in 2007 alone, will honour Richard Griffith the celebrated geologist and engineer, who lived from 1784 to 1878. It will bolster the research agenda of the programme targeting the vital pillars of energy, environment, marine and infrastructure, “all issues which are central to the success of the National Development Plan”.

The Awards Scheme reflects one of the central tenets of the geoscience programme – that of being composed on an all-island basis. As reflected on by the President of the RIA, Dr. Jim Slevin, “geological parameters do not recognise political borders so this strategy has been explicitly created in an inclusive “All-Island” context.” He went on to outline how there has been a long history of such inclusiveness in the geoscience sector and highlighted the recent publication of a Bedrock Geological Map of Ireland, produced in partnership by both Geological Surveys on this island.

The budget allocation will allow the GSI to spearhead Ireland’s participation in major international observation initiatives over the coming years. The strategy lists several but arguably the most topical is in the area of climate change.

Minister Dempsey noted that the “Geoscience Strategy will have a major impact on the way it delivers its information and services.” As if to emphasise this he went on to announce that “GSI will make its data available free of charge to customers over the Internet so promoting the maximum use of GSI’s data, both in Ireland and abroad.”

This policy will encourage new developments in the knowledge economy and facilitate an increased research agenda for new discoveries and economic benefits. All in all then, changing and challenging times ahead for GSI!

Enda Gallagher, GSI
Dr. Bettie Higgs, the author, has been working under the guidance of the Carnegie Foundation for the Advancement of Teaching, world leaders in research into teaching methods and student learning in higher education. She was awarded a scholarship for the academic year 2005-2006, and chose to investigate the student learning that takes place during an undergraduate geological field trips.

“Geology is the central science from which all other sciences emanate”. Well, this is what I tell my students on their first day in University College Cork. Together, we discuss ‘what is geology?’ and “where does geology meet, overlap and connect with other science disciplines?”

For the rest of the semester I ‘teach geology’ and leave the students to make the connections themselves - until now.

My current research is looking at ways to help first year students develop their capacities to deepen, connect up and integrate their learning – capacities that should stay with them and develop during the rest of their studies and beyond.

**Barriers to science learning**

In some first year science programmes the students study a series of discrete modules in parallel disciplines, with coordinators reporting “students can’t seem to transfer their knowledge and skills from one module to another”. Indeed assessment practices lead students to believe that their courses are self-sufficient and separate.

The traditional first-year geological residential field course, an endangered species, is defended by claims ‘this is where the real learning occurs’. However, little evidence of this, except anecdotal, has been forthcoming. Student feedback suggests field courses are popular, but when asked to apply their learning, in the form of synthesis for example, students often cannot demonstrate understanding. The traditional field trip can be more akin to a lecture in the field, with students writing down whatever the lecturer says, rather than recording their own observations and interpretations. Students who can write quickly and neatly are rewarded when the notebooks are collected for assessment. There may be little opportunity for students on the course to practice being scientists!

**Changes afoot:**

The residential geological field course could be a model of integrative learning in science, that is, an opportunity to help students connect up the science learning that has taken place during the year. The natural laboratory shows us that everything is connected and students should see and feel that this is the case.

**New directions:**

In an effort to progress this vision the first-year residential course in UCC was transformed from essentially a ‘series of lectures in the field’ into ‘seminars in the field’. Along the north Antrim Coast in Ireland, students carried out activities in groups of 8, with a leader to guide their work. In addition to traditional geological observation, recording of evidence and interpretation, opportunities for connection-making with other science disciplines were increased and made more explicit. These opportunities were referred to as ‘wormholes’ – pathways to parallel universes (or in our case, other science disciplines). An example of a wormhole activity involved simply taking a soil pH test when a new bedrock type was encountered. Here we could connect the
and beneficial. Our field studies were helped immensely from this project and the acquired skills will aid us in the future. A lot was put into this project and we all got a lot out of it.”

Activities to raise student awareness of their own learning and provide leaders with evidence of student learning, were woven into the scientific work throughout the field course. For example, in an attempt to look at how students come to understand things, I asked them to record their ‘ah-hah’ moments at any time during the course, that is, when a light goes on and something clicks in their understanding. How did it come about? What became clear? The student answers were tremendously revealing.

The data gave me insights into where students find difficulty connecting their learning when on campus. Students wrote: “Seeing the dyke intrusion on Cushendun Beach – makes a far better impact than seeing it in diagrams. It was great to see the size and scale of geology at work”; “when researching landslips I was having trouble understanding how rotational slips happened, but after seeing one, the 3D explained itself”; “Yesterday when we were looking at the Dailradian and Carboniferous rocks at Murlough Bay I found it hard to see how there was such an age gap between the two of them, then I thought of the fact there was a fault. That was an ah-hah moment!”; “When we were at Portrush discussing whether or not igneous rocks were precipitated out of sea-water. A few of us were discussing what could have happened. We came up with the idea that magma was coming into marine environment mudstone and that with the heat it baked the mudstone into a fine-grained splintery rock. It was an ah-hah moment because it turned out to be right!” Here the students have realised that they can think through a puzzle, discussing it with peers, and come up with a worthwhile conclusion. They are learning to be scientists. How do I know they engaged seriously? Students answered these questions in their own words and no two answers were the same. Many of the recorded ah-hah moments are what Perkins (2000) calls breakthrough thinking, when a student ‘gets it’ by struggling to make sense of messy data. This makes for robust learning.

The most challenging activity of the course gave many students their ah-hah moment. In White Rocks Bay students were told of 2 current theories for the formation and spatial relationships of the chalk and basalt. They had to examine the geological evidence for themselves, debate and defend their interpretations, and come to their own conclusions.
“Things became very clear due to in-depth discussion on the two theories”; “this was my favourite activity”. The high level of student engagement showed that traditionally I had not challenged the students sufficiently. Students were asked to reflect on ‘what did you learn from others in your group?’, and ‘what did you learn from other groups?’, to raise awareness of good practice in scientific investigation. To conclude, students were asked simply “What questions remain?” The level of questions constructed revealed much about the student’s attitude towards learning. Six levels of question were recognised, from the simple ‘what is the right answer?’ to sophisticated questions pushing us all to find out more. The interesting thing is that all of the students had the prior knowledge to ask the more complex questions – so why didn’t they? Is it just attitude, or do they need more practice at formulating good questions?

Evening synthesis activities, such as constructing geological columns and cross-sections, mirrored the work of real field geologists, helping students to connect the various pieces of information gained through the day. Students reported “We needed these [evening sessions] to pull things together”; “At White Rocks Bay, when discussing the different methods that possibly formed it - the discussion in the evening with everyone’s view, that was my ah-hah moment”.

Attitudes to learning? To begin to redress the ‘note-book’ emphasis in student assessment, I attempted to reward attitudes to learning. Criteria such as ‘attentive; asks for clarification; volunteers;’ through to ‘brings different pieces of learning together; proposes; solves’ were used. The students were aware of this and it appeared to have an impact on their engagement. It was possible to recognise different levels of integrative learning, with students moving between the levels depending on their own attitudes to learning.

The teaching role? The residential arrangement meant that leaders had multiple conversations about what was working and what insights they were getting. Ideas were generated about how things might work better. These conversations do not always happen on campus. In this ‘seminar in the field’ approach the student voice became prominent, and the roles of teachers and learners changed, with both learning from each other. It seems that the most physically and mentally demanding activities stood out as the most enjoyable. We concluded that students have not traditionally been challenged enough and that their range of abilities have not been assessed.

In November 2006 the author reported these and other findings at the ‘International Society for the Scholarship of Teaching and Learning’ Conference in Washington D.C. A more detailed report can be obtained from b.higgs@ucc.ie.

Acknowledgements: The author would like to thanks her co-leaders and the 2005-06 first year students

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Ode to the Granite Tors

By David Kirk

Oh, how they’ve argued over how you came to be carved, shaped. Prising icy fingers? Seeping acid rain? In the joints of your long cooled magma womb, exposed by time to light and life.

Whatever

They’ve thought up many mighty words to tell your story - congelifraction, solifluction, exhumation. Disintegration or decay?

Words that seek to tell a How but cannot tell a Why.

Whatever

You are, And that’s a thing. Summit-bursting towers, tors. Pure crystal from the crucible, age-greyed. Majestic. Elemental art. Curves that call the caressing hand. Clefts that call the wind and sing with it.

Sculptures of the earth-gods, Dwellings for the earth-gods, Aspirations for the agile. Transcendent Watching life stream by below, Ebb and flow, ebb and flow Thus you are Thus you will be when we have been and gone And that’s an end to it.

Earth Science Ireland Magazine

Post-grad teaching assistants l to r, John Savage Mairi Gardiner, Meg Ennis and Rory O’Donnell.
GALWAY PRODUCE NEW TEACHING RESOURCE

Following on the heels of their geological heritage CD-Rom (Galway County in Stone: The Twelve Bens), Dr. Martin Feely and Ronán Hennessy of the Earth and Ocean Science Department at NUI Galway have just released a new educational CD-Rom: GeoFIS – Geo-Multimedia for Second Level Geography.

Designed as a geography teaching resource to accompany the revised Leaving Certificate Geography syllabus (2004), the CD-Rom is currently being distributed to all second level schools throughout Ireland. Produced with the support of the Geography Support Service and Galway County Heritage Forum, the CD-Rom is designed as a multimedia website, and operates with or without Internet connection.

The ‘autorun’ functionality ensures that there is no setup or installation necessary to access the media – a feature that will prove appealing to technophobes and technosavants alike! In consideration of the often times discomfort in reading literature on screen, interactive animations and graphics are used throughout the CD-Rom to explain the featured geological phenomena.

The importance of integrating information and communication technology (ICT) into the geography curriculum is widely recognised (Guidelines for Teachers, Leaving Certificate Geography, An Roinn Oideachas agus Eolaíochta 2004), and the featured content of the CD-Rom endeavours to support this acknowledgment.

Covering topics that include plate tectonics, the rock cycle, landforms, GIS, satellite imagery and aerial photography, the content is equally of interest to students as to their teachers. User controlled animations featuring topics such as plate subduction, the rock cycle and aerial photography, allows for interaction with the multimedia, and removes the strictly ‘observational’ manner in which many websites are accessed.

A section dedicated to the use of Google Earth as a geographical visualisation tool in schools provides users with links to global locations (placemarks) of interest in Google Earth. To reduce the download time the necessary installation files for Google Earth 4 are provided on the CD-Rom. In addition, an easy-to-complete tutorial on creating a customised placemark in Google Earth is provided as a PDF user guide. It is hoped that through this introduction to Google Earth for earth visualisation, users will endeavour to explore the Google Earth’s potential for further syllabus-related content.

Building on the provision of ICT support for teachers, a tutorial on displaying real-time Earthquake data in a GIS is also featured on the CD-Rom. The necessary GIS software is also provided on the CD-Rom, in the form of ESRI’s free available ArcExplorer Java Edition for Education (AEJEE).

The landform section focuses on the landscape of the Roundstone area in County Galway. The use of Flash animations and photo-galleries provides an insight into the celebrated calcareous sands of Dog’s Bay, the distribution of offshore biogenic sediments and the vegetation on the Dog’s and Gurteen Bay tombolo.

In addition to the content featured on the CD-Rom, information can be accessed through a variety of links to external websites such as the European Space Agency, the Geological Survey of Ireland and the Central Statistics Office.
WHAT’S ON

**Belfast Geologists’ Society**

After more than 50 years ‘in the field’ organising stimulating Winter lecture programmes and exhilarating (if somewhat soggy at times!) summer expeditions around the north of Ireland and across the water, Belfast Geologists’ Society is putting together a programme for this summer that promises to be in its finest traditions.

Anyone with an interest in the Earth sciences is welcome to come along on the outings, which represent a wide geographical spread of venues and a big diversity of geological interest. Dates and venues of some events have not been announced at time of going to Press but details can be obtained from the contacts listed at the end.

This year’s programme kicks off with a trip to **South Donegal on April 13-14** where Garth Earls of GSNI will tell a story covering 400 million years, stretching from the Blue Stacks granites to the ice age drumlins. **Donegal will receive a second visit on June 9-10**, this time to the north, when Bernard Anderson will interpret the metamorphic complexities of the area, which includes some of Ireland’s oldest rocks.

**A trip with a difference in May** will see members taking to the sea-weather permitting! - to get a ‘big picture’ of the Giant’s Causeway Coast cliffs and basalt formations from a boat and have them explained by Paul Lyle (Advance booking necessary for this). Also in a May evening excursion Laverne Bell will give members a rare chance to see what can be revealed in the exposures of **a working quarry**.

During another evening trip on **Tuesday June 19** BGS Secretary Peter Millar will explain the geology of the Antrim Coast between Port Muck and Brown’s Bay and further north on the Antrim coast on **July 21** Andrew Jeram will interpret the Carboniferous formations of the Ballycastle area.

Other events planned but not yet fixed in the calendar will be a foray through part of Ireland’s **karst landscape** led by Geopark Geologist Kirstin Lemon and a look at the challenges posed by **unstable coastal landscapes** with Professor Bernard Smith

For further details of times and meeting places for any of these events you can contact BGS Secretary Peter Millar - Email peter.millar@nireland.com; Tel: Belfast 9064 2886 or David Kirk – Email davidkirk@ntlworld.com; Tel: Belfast 9096 0552. **Or check the ES2k website.**

**Cork Geological Association**

Founded in 1992 the Association welcomes anyone with an interest, or wanting to develop an interest, in Earth science. You do not have to know any geology to join in! There are still a couple of indoor events on the programme. On **25th April at 8pm** Dr Pádraig Whelan discusses “A Botanist’s Eye-view of Galapagos Geology” in the Lecture Theatre, Dept of Geology, UCC, off Donovan’s Road, Cork. Then, a good night for newcomers to ‘dip their toe in the water’ – and we hope they find us warm and friendly – is the **AGM and Members’ Night on 30th May at 8pm**. It is held in G8, the Ted Neville Geological Laboratory, Science Building, UCC.

Field trips started in March with a visit to see the fossils of Hook Head. Next comes a field trip to South Wales held over the last weekend of April. You will get this magazine too late to join in but it shows that the Association sometimes spreads its wings, in this case to see some classic rocks and fossils in the company of a Welsh host society. **Saturday 16th June** is sure to be popular with a visit to **Whiting Bay and Goat Island, Co Waterford**, leader Dr Ed Jarvis of the Open University. Meet at 10.30am in the Whiting Bay Car Park (the one nearer Ardmore).

The Chairperson of the CGA this year is Irene Twomey, 44 Wilton Gardens, Cork Tel: (021) 4545317 who will be delighted to answer any queries you might have about these or other events later in the summer.

**Belfast Naturalists’ Field Club**

The Belfast Naturalist’s Field Club (144 years on and still going strong) is an amateur organization whose aim is to study all aspects of Nature. The Club is subdivided into four Sections, one of which is Geology. To wet your appetite here’s what we did last year...

We began with a talk by Gareth Earls (Director GSNI) on tsunamis, updated with pictures from the deep-sea survey by H.M.S. Scott. We were left with the thought that tsunamis had occurred very close to home, and probably more than once.

The public like to touch and handle rocks so we took a selection of fossils
to demonstrate the geological time scale to the Castle Espie “Animal Magic” event.

Then the Belfast Geologists’ Society joined us for a talk on the chemistry of gemstones. There was a small selection of gems to be identified and many Members were horrified to learn all these “gems” were glass imitations. Buyers beware.

Kenneth James (Ulster Museum) took us to look at the building stones of Downpatrick where he taught us to really look at buildings, and we ended in Ballydougan Mill for hot coffee.

Bernard Anderson taught us how to identify graptolites at Donaghadee. Graptolites are one of the few organisms that became simpler as they evolved. We were amazed to learn that these “pencil marks” on the rocks were once living animals. A muddy and happy experience but the tide chased us home.

The final excursion was looking at igneous rocks of the Mourne Mountains with Shirley Gray and Philip Doughty. We started at Bloody Bridge and walked up the track to look at the junction of the Silurian mudstones with the granite and then climbed higher to see the boundaries of a huge pendant of Silurian rock hanging in the granite. The afternoon was spent in Cunningham’s stone yard. What an Aladdin’s cave. This firm specialises in polished decorative stone products including worktops for kitchens. There were about a hundred varieties of stone to choose from including an Indian granulite with garnets called Kashmir White and, possibly my favourite, a black gabbro with gold flecks known as Star Galaxy.

**Coming soon**

This year, amongst other things, we plan (May 19th) to look at the rocks of the Cookstown area, examine (4th August) the effect of geology, especially mining, on the communities around Glenarm and Glenravel with Ann Givan and (14th August) to visit the Paeoecology Laboratory at Queens University with Jonathan Pilcher. You are welcome to join us – more details at www.habitas.org.uk/bnfc.

**Sand dune dynamics in Co Donegal – the human impact**

The archaeological record of Irish sand dunes is very rich and diverse, but can yield a first-order assessment of the impacts of humans on dune dynamics. The precise relationships between human occupation of sand dunes and dune dynamics, however, are difficult to pinpoint. This arises because, first, the timing of human occupation is time-transgressive across the landscape, and is difficult to date; and second, sand dunes are dynamically responsive to wind and wave, climate and sediment supply. This latter point means that it is difficult to disentangle any signatures of human disturbance of sand dunes from the background ‘noise’ exerted by natural response of the dunes to climate.

We have been considering the impact of human activities on the long-term dynamics of sand dunes along the sandy coasts and estuaries of west County Donegal. We have already shown that these sandy coasts are highly responsive to North Atlantic climate; but middens, hearth sites, and charcoal-rich soils (attesting to human activity over long time periods) are also present in the sand dunes. At sites around Loughros Beg (both located west of Ardara) and Carrickfinn organic-rich layers (buried soils and peats) are associated with distinctive archaeological remains including pottery, tools and bones (mainly of the Bronze Age). Whilst these remains provide direct evidence for human occupation at certain time periods, they do not shed light on indirect effects of human activity such as disturbance of the natural sediment dynamics of the sand dunes. In a forthcoming paper we show, for the first time, that build-up of hearths and shell middens provided a source of distinctive sediment into the sand dune system. Subsequent reworking of this sediment can help “fingerprint” the temporal impact of human activity on dune systems (likely 5-10 years in scale). Our future research will investigate this concept in more detail from other sensitive sand dune systems.


**Jasper Knight, University of Exeter** (j.knight@exeter.ac.uk)

**Helene Burningham, University College London** (h.burningham@ucl.ac.uk)
WALK WITH WEBBED FEET . . .

Says David Kirk

What do ramblers, scramblers and Earth scientists have in common?

Well apart from the elite status they naturally enjoy among the ranks of men, brave souls and searching minds, one thing draws them together - they are hooked on landscapes.

Exploring them, wondering at their endless diversity, sometimes challenging them – and ever seeking to explain them - these are what inspire.

Ramblers ramble, climbers clamber, geologists geologise – and all eulogise.

Geo-ologists of course can ramble so why can’t amblers geologise? The answer is of course they can - and most who make the effort find it addictive. Just add a touch of cerebral exercise to your physical, learn to read the landscapes you’re enjoying and it will add a whole new and fascinating dimension to your days in the great outdoors.

This is quite profound – the social, cultural and economic patterns of human communities have been deeply influenced by the landscapes that shape their environment and each individual carries their stamp. Seeking to understand the landscapes around you and the geological forces that shaped them is to enhance understanding of the background to our own lives.

So, for added-value rambling and scrambling, get into Earth science – being a rock-hound is just so cool!

Fortunately aside from their esoteric day jobs there are no people more enthusiastic about ‘sharing’ their science and their landscapes with anyone interested than Ireland’s professional geologists.

Recent years have seen the publication of a number of first-class books by experts who tell the story in language easily understood by the beginner. Some, such as Paul Lyle’s ‘The North of Ireland’ contain excellent trail guides to different regions of geological drama - in this case guides to individual sites within, say, Mourne or the Causeway Coast, rather than walking guides as such - but you can always create a walking route between them. (Do you good!).

For more than 10 years now the ‘temples’ of earth science, the Geological Surveys of Ireland and of Northern Ireland have been collaborating to reveal the secrets of our landscapes to the public and to promote landscape tourism across the northern counties of the island. Under their ‘Landscapes from Stone’ brand they have a series of superb regional geo-walk packs – 10 weatherproof walk cards in each.

There is also the ‘Explore’ series of (currently) 11 excellently informative geological guides to various regions such as The Sperrins and West Sligo, offering excursions for the car-equipped visitor.

And now of course we’re in the cyber age where everything you want to know can be found on the web. Again the Geological Surveys are in the lead in presenting material of interest to those wanting to find out more about how the landscapes were formed, but there are other sites too with excellent material (see selection of website addresses below).

For any rambler wanting to find what geological features of interest there are in an area of Northern Ireland they plan to explore the Earth Science Conservation Review – ESCR - (found in the geology section of the Ulster Museum’s website www.habitas.org.uk) will be an invaluable resource. It’s worth exploring it before setting out.

The ESCR, run in partnership with the Northern Ireland Environment and Heritage Service, lists some 350 sites of geological or geomorphological (landscape-shaping) importance. These are assessed and classified and so far almost 80 have been designated as Areas of Special Scientific Interest.

If you know the name of a feature where you will be walking, such as Altmore Burn at Glenariff, you can find it alphabetically, or you can call up county lists to plan a walk. Grid co-ordinates are given for each site and also the geological age in the evolutionary story, e.g. Carboniferous, which it represents.

We will be telling you more about the ESCR in the next issue of this magazine. Meanwhile, apart from the Habitas website mentioned above, you can visit the Geological Survey of Northern Ireland at www.bgs.ac.uk/gsni and the Geological Survey of Ireland at www.gsi.ie. The NI Environment and Heritage Service at www.ehsni.gov.uk/natural/earth/geology is excellent and for student-level geology try www.geographyinaction.co.uk . You can also do a Google search on ‘geology ireland’ – there’s stacks of stuff.

Enjoy your enlightened rambling.
Job Profile -

FOCUS ON MARIE

Dr Marie Cowan, Past Secretary of ES2k, answered questions put to her by the Editor

Tell us a little about your background.

I am a past pupil of Sacred Heart Grammar School in Newry and earned my 1st class honours in Geology and PhD at Queen’s University Belfast. Since then I have worked as a university demonstrator, lecturer and conference organiser, for an international oil company, as a geological consultant, and a spell at HM Customs and Excise.

Sean and I live in Hilltown and have two children, Clare and Patrick. I am a parent governor at St.Patrick’s Primary School in Hilltown, gaining an understanding of the challenges facing primary educators. As a Science and Engineering Ambassador with Sentinus I will play my part in encouraging the uptake of the sciences amongst secondary pupils.

You have jumped on a bit. You have worked for the Geological Survey of Northern Ireland since 2004? Yes. I am part of its Tellus Project team. My job is to lead the outreach programme to inform the public about the aerial survey and when and where the plane will be flying, as well as letting people know about the ground survey. The outreach programme specifically targets our interested groups such as the agricultural community, landowners, riding schools and district councils. Another key aim is to raise awareness of the Tellus results across four key sectors; central and local government, the private sector, the academic community and the general public. There is no precedent that I am aware of in Great Britain or Europe.

What is Tellus? It is a project to systematically collect and analyse soil and water samples all across Northern Ireland in conjunction with a low altitude air survey that will add much detail to what we already know about our rocks and superficial deposits. It started in May 2004, the data collection is now over and we are now doing the exciting bit, working out what it all means.

A low flying plane must have been difficult to explain. We sent out letters to all landowners, had a telephone hotline and went out to speak to everyone we could. A public relations firm Weber Shandwick, with which we won the PRCA Excellence Award presented by An Taoiseach Bertie Ahern, also advised us. Once people knew what it was all about they were tremendously supportive. There was a considerable awareness of the project amongst secondary schools resulting from a series of events including a GSNI open day, schools debate, and student work experience and school challenge day at W5.

What impact will the project have on our lives? We will know more about minerals, aggregates and land quality so that the raw materials necessary to build our homes, schools, hospitals, businesses can be located and managed in a responsible way. The same applies to the minerals and compounds used by our agricultural, industrial, construction, medical and service industries, which provide stability to the economy in Northern Ireland. Perhaps most important is the establishment of an environmental baseline so future changes in land and water quality, for instance due to use of chemicals on soils or atmospheric pollution, can be monitored. It is the quality of life for our families, our livestock and our wildlife habitats that we will be better able to protect in the future. I don’t think there could be a much bigger potential impact.

What does the future hold for you now this phase of Tellus is ending? I have already, to an extent, moved on. I am working as Press Officer for the British Geological Survey. I am still based in Belfast but travel regularly to Nottingham. You will now find my name beneath press releases like ‘Intergovernmental Panel on Climate Change’, ‘Time machine to help communities discover the restoration potential of their local quarries’ and ‘Future of Afghanistan grounded in copper’.

I can honestly say that I love my job as it fuses a continued involvement in geology with the scope to use my communications skills. I am delighted to play a part in what are momentous times for the Earth sciences in Ireland and the UK.
The Belleek Pottery started because of the immediate source of waterpower from the River Erne and a local source of feldspar. Belleek is situated on the Donegal/Fermanagh border and well worth a visit – to see the pottery, the countryside and a host of antiquities.

The rocks immediately to the north are some of the oldest in Ireland. They are well over 1000 million years old. They were originally mostly sandstone, deposited in an ancient sea, which during the ensuing millions of years went through considerable deformation and became recrystallised to give a rock termed psammite. The psammite is commonly quite coarse-grained and variably siliceous, feldspathic and micaceous. It is part of a sequence called the Lough Derg Group, of Moinean age. Take a drive along the road from Pettigo to Laghey to see easily accessible examples.

The interest for pottery was not in the main mass of the rock but in the quartz-feldspar pegmatite veins that cross-cut the psammite. They are from a few centimetres to about 3 metres thick. Some of the veins have up to 65% potash feldspar. The main feldspar workings in the thicker of these veins were situated about seven miles from Belleek in the direction of Boa Island in a townland called Larkhill. This is about two miles from Castlecaldwell, the ancestral home of John Caldwell Bloomfield the principal founder of the pottery factory.

When Fergus Cleary visited the remains of the mine workings some twenty years ago he says there were few visible signs except some waste heaps and a small pit. There were also remains of the track that carried the rails used to bring the wagons down to the main rail line at Castlecaldwell. The feldspar was then transported to Belleek and picked, fired and processed on site. In the early years some was also exported to England, mainly to Worcester.

Belleek Pottery used local feldspar for only a short time and it seems that the quality was not as good as expected. The production of porcelain required high-grade feldspar and it is likely that the local feldspar was only used for earthenware. Latterly all materials have been imported, feldspar from Norway and china clay from Cornwall. However the local feldspar mine did briefly reopen during the First World War.

The foundation stone for the pottery was laid in July 1857 and production started by the end of the year. It has a fascinating history of good and not so good times but has long established itself on the world stage for high quality and beautifully designed porcelain. Excellence in marketing is also important and pictured are some early products that have been reintroduced as limited editions to celebrate this significant anniversary. If you want to see more examples or learn more about the factory visit the website www.belleek.ie.

Earth Science Ireland congratulates Belleek and thanks Fergus Cleary, Head of Design at Belleek Pottery for supplying much of the above information and the fine photographs. The Editor takes full responsibility for the geological account!

Tony Bazley
New views on the Quaternary environments of SW Ireland

Recent work on the glacial and periglacial sediments and structures of western and south-western Ireland contributes to the continuing debate on the presence (or otherwise) of the Cork-Kerry ice cap, late Midlandian ice limits, sea-level position, and significance of periglacial sediments and structures. Several recent papers describing glacial sediments of the west coast show clear evidence for open-water (marine) sedimentation – and thus high sea-levels – during the late Midlandian glaciation. What is more remarkable is that this evidence comes from open, Atlantic-facing settings which would have been – as now – most sensitive to rapid climate change. More sites are currently under investigation.

The presence of periglacial structures and sediments in southernmost Ireland has traditionally been used to suggest the absence of glaciers in the landscape and to identify ice limits. What is surprising is that this view has been virtually unchallenged for many decades. In detail however, well-developed periglacial structures are found in areas both ‘inside’ and ‘outside’ ice limits across southern and south-western Ireland. These include periglacial involutions and, occasionally, frost wedges that are developed in ‘head’ and, occasionally, several metres thickness of wind-blown sand is also present. Whilst some of these structures are undoubtedly periglacial in origin, density-driven soft-sediment deformation is also common and may suggest water lain deposition of these sediments. Further study of these structures and sediments is ongoing, but this preliminary work certainly suggests a complex depositional history and very variable environments during the Quaternary of far southwest Ireland.

Jasper Knight, University of Exeter (j.knight@exeter.ac.uk)

References

Knight, J. 2006. Sub-ice shelf sediment deposition during the late Devensian glaciation in western Ireland. Marine Geology, 235, 229-240.


Noel McCann

The words ‘enthusiastic’, ‘inspirational’ and ‘hospitable’ spring to mind when remembering Noel McCann who passed away recently. He graduated from The Queen’s University of Belfast with a degree in geology in the late 1950’s and entered the oil industry that took him, amongst other places, to Trinidad. Then, in the middle 1970’s, he returned to the north of Ireland.

Noel then turned his hand to teaching and will long be remembered by those he steered through exams at Down High School, Downpatrick. He was, as one student said, simply inspirational. He made geology an attractive subject, helping to keep the teaching of the subject alive in the Province. His enthusiasm also shone through at the Belfast Geologists’ Society meetings. He was one of the Society’s stalwarts for many years, leading field trips, giving talks and was unfailingly helpful. He was President of the Society from 1992 to 1994 and was also a Fellow of the Geological Society of London and a Chartered Geologist.

Noel will be sadly missed.

Editor
A new force in the landscape

David Kirk cautions us

Here’s a word to trip over – pedarhexistasy. It’s new; I’ve coined it to describe a landscape effect that may be tiny in the great geomorphological scheme of things but as a result of changing weather patterns is having an increasingly destructive impact on our mountain environments – and it’s all our own work!

In the mid-eighties I was involved with a pressure group to stop what had become a (too) popular annual event, the Mourne Wall Walk, which attracted four-figure numbers of people. A great event, a great challenge, great craic, but the damage those thousands of feet did to the vegetation, and the open wounds of the subsequent erosion, was such that 20 years on the scars are barely beginning to heal.

Now a new factor has appeared which is literally changing the face of the hillsides in places. Probably as a result of global warming (for which we ourselves again are at least partly to blame) mountain weather patterns have changed dramatically over the past few years as any regular hillwalker can testify. The soggy foggy days and the bright purple days are always with us of course but increasingly a pattern is developing of prolonged dry spells interrupted by incredibly heavy downpours and very violent winds.

More than 90 per cent by volume of peat consists of water and in normal conditions, when it remains ‘wet’, rainfall does not wash it away - it fairly laps it up in fact. Most rain soaks down until it meets an impervious layer, iron-pan or rock, to drain away; sometimes it drains away through the labyrinths of small tunnels that everywhere permeate the peat layer (see picture). The damage to exposed peat is done by sunshine and drying winds which desiccate the surface layers. This cannot rehydrate and so the next rainfall just washes away what the wind hasn’t blown away. In winter frost-heave has the same effect, separating a surface layer and leaving it lying loose. But even thirsty peat cannot cope with the vast amounts of rushing water that today’s torrential storms dump, perhaps in a matter of
minutes. The water naturally streams down the slopes, its power dissipated by the grass and heather, until it finds a channel, maybe in the form of a bared track, and channels into a destructive ‘flash torrent’.

In addition there is a quantum leap in its cutting power when a layer of grit and gravel is exposed, giving the water sharp-edged tools than can quickly strip away peat and soil, to expose even more stones (the size of particles that water can move is proportional to the square of its speed – increase speed 10 times and it can carry stones 100 times bigger).

Pictured here is a deep gully in the Mournes. Just three years ago this was just a faint track through the heather at the top of the picture; gravel-laden water has cut more than two feet down through not just the peat and the gravel but a rock-hard layer of iron-pan. This is a dramatic example of a phenomenon that is increasingly to be seen across Ireland’s hills wherever the peat or soil surface has been breached.

In places hillsides are also newly marked by ‘petrified’ rivers – spreading streaks of bleached gravel and rocks washed out further up and left lying as the torrents spread and slowed.

There is a new force at work in our landscapes – tread carefully!

NEW APPOINTMENT AT QUEENS

We were very pleased to welcome **Professor Keith Bennett** onto the staff in Queen's University, Belfast’s School of Geography, Archaeology & Palaeoecology in January. Some readers may know Keith as the author of the textbook ‘Palaeobiology’. He has previously been at Cambridge, Toronto and Uppsala. His interests include Quaternary evolution of Kamchatka and western South America.  

**Alistair Ruffell**

EXPERTISE GOING ABROAD

John Arthurs, a graduate of Trinity College, Dublin and past Director of the Geological Survey of Northern Ireland has been prospecting for valuable minerals in Zambia. Last year he lectured, between safaris, to the Belfast Geologists’ Society. Zambia is part of the African Copper Belt and although some of the wildlife looked a bit scary it shows where a geology degree can lead you.

Interestingly, in his talk, he linked the formation of the Zambian peneplain shown in the photograph to our own Antrim volcanic lavas. The link? They formed at about the same time around 60 million years ago. The distant hills rising out of the peneplain in the photograph are called ‘monadnocks’, one of those words you might come across in a pub quiz.

**We picture the African Eagle Resources Field Team with (l to r) Chris Davies (Operations Director), Brian Zulu (Field Assistant), William Mumba (Geologist) and John (Group Consulting Geologist).**

**The distant hills were formed about the same time as the basalt lava flowed out over County Antrim**

**Issue 1**
If you are near Maghera, Swatragh, Kilrea and Bellaghy in County Londonderry or Rasharkin, Cullybackey, Ahoghill and Newferry in County Antrim then you are in the area of this map. All names to excite the imagination and you just have to love a map like this. So brightly coloured that questions leap off the paper as you read it. Questions that are answered in an extremely well written script that brilliantly links history, geology and landscape. Photographs add to the appeal. Yet, driving across the area, the topography looks quite subdued, the highest point being just over 400 metres as shown on the cover picture of the handily folded map.

So what gives the map its appeal? Most obvious are the masses of elongate hills (drumlins) ‘marching’ across the map. The crestline of each hill is shown and they accurately portray the direction the last ice sheet moved across the area. There is a sand and gravel ridge (esker) that snakes its way across the ground for about 8 kilometres, representing a river that flowed below the ice as it was melting. The major River Bann and smaller River Main, with associated sandy deposits, flow across the area and there are spectacular glacial meltwater channels in the west. So this is excellent ground for the Quaternary geologist.

The solid rock is mostly volcanic basalt lava, with older rocks only along the western side of the map where the oldest, Dalradian-age rocks, make up the highest ground. Mostly basalt lava sounds dull but the question is “what lies beneath the lava?” A coloured cross-section gives a professional interpretation but there is only certainty in the southeast corner. Here an exploration borehole was drilled down to a depth of 2272 metres. The full log is given. It went through 769 metres of lava (imagine the pyrotechnics and effect on the climate at the time!) and then a huge thickness of Permo-Triassic rocks. It didn’t quite reach the older Carboniferous rocks that probably lie below and might hold oil and gas. The Tellus Project helped with the interpretation of the deep rocks but still there are questions that another generation will have to answer. Such is the fascination of geology.

The map costs £4.50 from the Geological Survey of Northern Ireland.

(Is the Editor rather too enthusiastic about this map? If you think so please buy the map to test his impartiality – and forgive him as he was one of the surveyors)

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**MAGHERA - NEW MAP, 1:50,000 Scale**

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**Editor comments**

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**IRISH GEOLOGY WEEK 1st – 7th MAY 2007**

**NORTHERN REGION**

**Tuesday 1st May**
- Social: ‘Poetry in Landscape’ – 19.30 18 – 22 Black Box Theatre, Hill Street, Belfast
  - email contact mark.cooper@dentl.gov.uk

**Wednesday 2nd May**
- Laidback lecture: Druids & Drumlins, Dr Robbie Meehan, Cavan Town Library 7pm
  - email contact Kirstin.Lemon@fermanagh.gov.uk
- Excursion: Glaciers, sea-levels, sand and plants – the natural history of Killard National Nature Reserve. Ian Enlander. 2pm. Killard
  - email contact ian.enlander@doeni.gov.uk

**Thursday 3rd May**
- Laidback lecture: Rock around the Lough: A trip around Belfast Lough. Ian Enlander. 7pm Carrickfergus Castle.
  - email contact ian.enlander@doeni.gov.uk

**Saturday 5th May**
- Excursion: The natural heritage of Cuilcagh Mountain, Leader: Dr Kirstin Lemon, 10am.
  - Market House, Blacklion
  - email contact Kirstin.Lemon@fermanagh.gov.uk
- Excursion: Blast from the Past – the volcanic history of Carrickarede, Co. Antrim.
  - Ian Enlander, 2pm. Carrickarede
  - email contact ian.enlander@doeni.gov.uk

**Sunday 6th May**
- Excursion: The Building Stone of Belfast. Alan Bell. 10.00 am. Waterfront Hall
  - email contact allan@nda.sc.uk
- Hands-on: ‘Go Get Geoscience’ at W6, Odyssey Centre, Belfast. Fossil making, fossil rubbing, and gold panning - fun for the family. 2 – 6pm.
  - email contact marie.cowan@dentl.gov.uk

**Monday 7th May**
- Hands on: Fantastic Fermanagh Fossils. Fossil Fun Day at Marble Arch Caves. 11am to 4pm.
  - email contact Kirstin.Lemon@fermanagh.gov.uk
- Excursion: The Real Jurassic Park. Dr. Mike Simms. 10.30a.m.Larne Promenade
  - email contact michael.simms@magni.org.uk

Visit [www.habitas.org.uk/es2k](http://www.habitas.org.uk/es2k) for further details of all events or email ian.enlander@doeni.gov.uk
Ballymagreehan Quarry on a cold, damp day in early spring may not everyone’s choice of venue but for hardy members of the Belfast Geologists’ Society it proved an eye-opener. Situated just outside Castlewellan in County Down it lies within an area that may soon be included in Northern Ireland’s first National Park.

The Mourne Mountains rear up from the sea just a handful of kilometres to the south but they are made of young granites just 56 million years old whereas the ‘granite’ of Ballymagreehan dates to about 425 million years. The word granite is placed in parentheses because for the specialist petrologist this rock is classed as granodiorite. It has a composition just between granite and diorite but for ordinary mortals granite will do! It is part of the Newry Igneous Complex that lies north and west of the Mourne Mountains and stands out on any geological map of the region.

The quarry is well hidden and not very large but in its heyday stone went to the Philadelphia Exhibition in 1876, celebrating the 100th anniversary of the beginning of the American Revolution. There it was awarded a medal for its hardness and beauty. It was also used in the Albert Memorial at Hyde Park, London, for columns and steps. Especially long lengths of stone could be produced here; it is recorded that it took 8 men twenty weeks to make the four columns used in the Memorial.

Such stone, reputed to be the hardest granite in the world, was obviously popular locally and was used all over the Castlewellan area. Yet it cannot now be used to carry out repairs because planning permission to produce even limited amounts of dimension stone from Ballymagreehan Quarry is being refused. Is this to be regretted or should the competition from cheap imports of, for instance, Chinese granite be allowed to prevail?

To digress, in Scotland the demand for local stone seems to be on the rise and planners are allowing old quarries to reopen for special purposes. Global environmental concerns are making people wonder about the morality of transporting construction materials from distant parts of the world, with the energy therefore used. There is an increasing understanding that indigenous stone responds to local environmental conditions – it suits the landscape. Quarries are usually in rural situations where jobs are scarce and there is a body of historical expertise in the use of local stone, from stonemasons to architects. Quality can be more easily monitored from local sources and stone replacement for repairs is easier. Yet in spite of clear evidence that the energy used in producing local stone is less than that from abroad there is still an increasing flood of imported materials. Much the same can be said for Ireland and especially the Mourne Mountains. So the question has to be asked whether, even within a national park, requests for quarry reopening, even in a very limited way, should be automatically refused.

The granites of the Newry Igneous Complex formed from a molten magma that melted and incorporated some of the rock (sandstone) as it came into place. When first studied the idea in vogue was that the melting of sedimentary rocks, like sandstones, formed granites. The Newry granites certainly contain inclusions of country rock and were considered to prove the ‘granitization’ theory. The Newry rocks were taught to students all over the world.

The ‘students’ of this BGS geological trip went on to see an example of the skill of local stonemasons in Castlewellan. Standing impressively on one side of the town square is the Drumadonnell Stone Cross. It is a replica of the original from a...
graveyard in Drumgooland that had been incorporated into the wall of a school. The original is now in safe storage and McConnell’s Stone Yard Kilkeel used a combination of sophisticated scanning techniques and skilled hand carvers to make a very accurate replica. The rock is Mourne granite (G2 variety) and the replica was carved from granite originally from Thompson’s Quarry in Newcastle.

Next visited was St. Paul’s Church of Ireland built in 1853 and designed by the famous architect Charles Lanyon. A combination of Newry and Mournes granites were used. Mournes granite, being slightly easier to cut, is used for the intricate carving and dressed stonework. Apart from the need to have local stone available for renovation the importance of using appropriate mortar is clear. Inappropriate mortar mixes, such as hard impermeable cement pointing mortars, can force moisture movement in and around the stone causing accelerated decay or staining. Sandstone is especially vulnerable but hard mortars can also damage granite. Different porosity between different stone types can also cause problems. Cement mortars can also leach damaging calcium salts onto adjacent stones. Understanding the types of stone and the correct mortar to use is essential in the restoration of important old buildings.

Finally the group went to see St. Malachy’s Church, which was built in 1884. The stone came from two small local quarries, so there are two varieties of granite. The stonework on this church has been recently cleaned, much improving its appearance. An extension to the church was completed in 2004 and the stone used was Ballymagreehan granite so the refusal to allow that quarry

Joanne Curran (Joanne.curran@consarc-design.co.uk) is project manager for the ‘Natural Stone Database Project’, an Industry-Research partnership between the architectural practice - Consarc Design Group (Dawson Stelfox MBE) and Queen’s University Belfast (Professor Bernard Smith) funded by Building Sustainable Prosperity Programme.

The project will provide a database of information on our stone-built heritage through a comprehensive surveying and analysis programme of listed stone buildings and monuments throughout Northern Ireland. It will also identify available stone resources as, increasingly, knowledge of the supply of stone has been lost and the project aims to discover and open the channels between supply and demand again.

The Natural Stone Weathering on-line database will go ‘live’ in December 2007. Stonemason or architect, it will be a major help to anyone concerned with Northern Ireland’s built heritage.
to work is a new development. Perhaps
not sensible – what do our readers think?
Certainly this visit to Castlewellan, led
by Joanne Curran and Ian Meighan,
opened the eyes of the BGS members
to the importance of correctly using local
materials in building restoration.

**The End of the Last Glaciation in Northern Ireland**

**The Editor writes:**

This book reconstructs the sequence of
 glacial and climatic events between
 17,000 and 13,000 years ago. It brings
 the professional geologist up-to-date
 with recent University of Ulster research
 in Counties Monaghan, Louth, Down
 and Antrim. It sets the findings in their
 all-Ireland and the wider north Atlantic
 context. It is written by Marshall McCabe
 and Paul Dunlop and was published late
 in 2006 by the Geological Survey of
 Northern Ireland.

This is no dull academic-looking product.
 It is a bright, well-illustrated soft cover
 book of only 90 pages, available at just
 £10. A challenging read, it will none-
 the-less have a broad appeal from
 geologist and geographer to natural
 history amateur. You need only flick
 through the series of lovely photographs
 and coloured diagrams to start to feel
 excited about the evidence of glaciation
 we have on our doorsteps. So beautifully
 presented anyone picking this book up
 will learn something.

Like a detective story the evidence is
 pieced together from 13 sites and finally
 integrated into a convincing story of
 dramatic events in Ireland. Events that
 had a major impact on the landscape
 and are significant as we grapple with
 modern questions about climate change.

New dating techniques have been
 applied, some involving tiny fossils in
 marine muds, and have made it possible
to tie down times of ice melt-back to
 within a couple of hundred years. It
 shows in cartoon style how the ice sheet
 covering Ireland retreated and the front
 cover illustrates what was happening
 at the ice sheet edge when it lay
 along the south County Down coast
 around 14,000 years ago. It is a story
 that puts Irish Quaternary geology back
 at the leading edge of modern research.

If you are worried it is too technical
 for you, there is a very full glossary of
 terms and a good index. The authors are
 to be congratulated, as is the GSNI for
 publishing in such an attractive style. I
 have no hesitation in recommending this
 book to everyone. It can be obtained
 from the Geological Survey of Northern
 Ireland, Colby House, Stranmillis Court,
 Belfast BT9 5BF, Tel: 028 9038 8462,
 email: gsn@detni.gov.uk, Website: www.
bgs.ac.uk/gsni

**Dr IAIN C LEGG**

As we go to press it is with great
sadness that we learn Iain Legg died
on 12th March. Iain’s home was in
Bangor, County Down and he was for
many years a very highly respected
member of the geological community
in Ireland. He worked for the
Geological Survey of Northern Ireland
from 1977 to 1998, retiring as a
Principal Geologist. He contributed to
many maps and memoirs, including
those for Derrygonnelly & Marble
Arch and Newtownards, whilst always
maintaining an interest in ichnology
- those enigmatic trace fossils. In his
spare time, amongst other things, he
enjoyed the hobby of philately and is
reputed to have had a fine collection
of stamps.

Iain was President of the Belfast
Geologists’ Society 1991-1992 and
was a talented lecturer. He had a
strong interest in practical geology
that culminated in his leadership, as
President, of the Irish Association
for Economic Geology in 1994. He
coordinated mineral licensing in
Northern Ireland in the later part of
his career with the Survey. Those
who worked with Iain will not forget
his professionalism, willingness to
help and kindly nature.
ANCIENT MONUMENTS & LANDSCAPE

Especially...the Beltany Stone Circle, Co. Donegal

Paul Lyle looks at a site where pagan rituals were probably practised

Our ancestors fitted their monuments into the landscape

Archaeology has revealed much about the early settlers in Ireland, those people responsible for the great stone monuments that are such a prominent feature in many parts of the Irish landscape. The construction of monuments 4,600 years ago - cairns, tombs, standing stones or stone circles - reveals an appreciation of the landscape and a knowledge of the details of the geology of the area that is often undervalued by those seeking to interpret and explain the structures as seen in today’s landscape. It is clear that many of the monuments were built within the context of the wider landscape and often added to features in the landscape as a means of emphasizing and embellishing them. A good example of this is the addition of the large cairn known as Maeve’s Tomb on the prominent hill, Knocknarea, near Sligo. It was almost certainly built for its appearance when viewed from particular places, including (as shown) from the major Mesolithic cemetery at Carrowmore, about 7km to the west.

A development in the construction of monuments, which followed the building of megalithic tombs, was the erection of stone circles, stone rows or alignments and standing stones. It appears that individual stones had significance and the size, shape and perhaps rock type of the chosen stones was important. It has been recognized in Britain generally medium to coarse-grained quartz-rich schistose rocks; schistose meaning they having a tendency to show an alignment of the main mineral components and so would split into flattish-sided slabs. The pictures show the variation in height of the stones in the circle and also the prominent single stone outside the circle to the south. This single (lonely) stone is the exception! It is about 2.5m high and is a different rock type. It has a distinctly igneous texture (the minerals are randomly orientated, unlike metamorphic rocks), is coarse-grained and consists of a whitish mineral, probably feldspar, and a dark greenish mineral, probably hornblende, in roughly equal proportions.

Reference to the Geological Survey of Ireland (GSI) 1:100000 scale map of the immediate area around the stone circle shows that the bedrock making up the area around the circle is quartzite, quartz mica schist and marble (metamorphosed limestone). They are part of the ancient Dalradian Supergroup, about 1000 million years old. There is no reference made to igneous rocks in the near vicinity, so the presence of the igneous-textured outside stone is unexpected. Where did it come from? I will discuss that later but first we should consider the relationship between the landscape and the geology of the area.

The aim of this article is to consider aspects of the geology of the circle, both in the nature and distribution of the rock types making up the stones of the monument, as well as the wider landscape context of the circle and its surroundings.

Let’s start with the rock types used in the circle. All the upright rocks making up the circle are metamorphic rocks, the ring of stones can be said to be a small-scale representation of the larger scale landscape. The ring of stones can be said to be a small-scale representation of the larger scale landscape. From the centre of the ring the variable heights of the uprights can also be seen to approximately mirror
The landscape and main rock types around the Beltany Stone Circle. The 100m and 200m contour lines are shown in black. Marble outcrops are coloured blue, quartz-rich schistose rocks are yellow. Green is ‘epidiorite’. Sketch made on map provided courtesy of the Geological Survey of Ireland.

**Surrounding landscape/topography mirrored**

This topography around the Beltany Stone Circle can be directly related to the underlying bedrock geology of the area. My sketch shows the distribution of land, mostly just over 50m high with the stone circle, around a small hill that is just over 100m, at the centre of the diagram and the surrounding hills between 100m and just over 200m high.

The Stone Circle, as mentioned, sits on a small hill at an altitude of 90-100m. When the outcrops of bedrock are added to the topography as outlined by the 100m contours, there is a clear correlation between the higher ground and the occurrence of the harder quartz-rich rocks. In contrast softer, less erosion resistant, rocks of mica schist and marble dominate the lower ground between the hills.

For the geologist readers the distribution of the rock types in the area is largely controlled by the regional fault pattern, mostly trending in a northeast-southwest direction, with a complementary set of faults at right angles to this, running roughly northwest to southeast. Mongory Hill, about 4km to the north of Beltany and at 284m above sea-level one of the highest hills in the area, is formed of a folded block of the Dalradian rocks, specifically the Termon Formation and the younger Killeter Formation, which is predominantly quartzite. Most of the lower ground in the area is formed of the Killygordon Limestone Formation, predominantly marble, which is metamorphosed limestone, and mica schist. The small hill chosen by our ancestors as the site for the Beltany Stone Circle is formed from a faulted block of the Mullyfa Formation. This formation is mostly hard quartz-rich schist or psammitite, a metamorphosed sandstone.

Examination of the original field maps produced in the geological mapping of this part of Donegal (see sketch) showed outcrops of a rock named as “coarse-grained epidiorite”. This is an old-fashioned (catch-all) term used for dark coloured igneous rocks that have been metamorphosed, the shearing of the original gabbro, dolerite, diorite or basalt making it difficult to specifically identify the rock in the field. In this part of Donegal igneous rocks of this type are relatively rare and are certainly distinctive in appearance. Examination of the locality at Croaghan Hill, some 5km to the southeast of the Beltany Stone Circle, revealed a coarse-grained rock with a randomly orientated crystalline texture, composed predominantly of feldspar and hornblende, giving a marked speckled appearance. It is very similar to the standing stone outside the stone circle at Beltany and the area around Croaghan Hill could certainly be considered as its source. It is interesting to note that Croaghan Hill itself was also a significant locality in Neolithic times with a hill fort and cairn remaining at its summit. It might be suggested that this lone standing stone was a glacial erratic dropped by the ice in the vicinity of Beltany but the relatively long and narrow shape of the stone strongly suggests to me that the block was quarried from outcrop.

Why did the Neolithic people use one rock type in the construction of the stone circle and another, quite different rock type, for the single standing stone outside the circle? One possibility is differences in colour and reflectivity. Since these stones have been exposed to the ravages of the atmosphere for thousands of years they are deeply weathered and commonly covered in lichens. Their colour is often obscured. When freshly erected how different they would have looked. The uprights of the circle, quartz and mica schists, would have been light coloured, often a golden-brown shade; the mica would have sparkled in the sunshine and on a bright moonlit night. By contrast the solitary upright outside the circle would have a colour and reflectivity dominated by the dark green of the hornblende and the dull feldspar; in comparison it would have appeared almost black.

Suggestions are that 4,000 years ago it might have been a ritual site for the changing seasons, a great passage tomb, an astrological clock for the farmers of the time – or for other pagan practises. Is the clue in the name? Beltany might come from ‘Baal Tine’ that translates as ‘Baals Fire’ and could suggest the pagan practise of sun or fire worship. How does a ring of sparkling stones and one black stone standing outside fit into the equation? We can only wonder but the set-up can hardly have been anything other than deliberate.

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