

ES2k

Earth Science 2000
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Editorial

THE END OF THE BEGINNING?

The ES2k Magazine is spinning into another journal, **SCIENCE SPIN – Ireland's Science, Wildlife and Discovery Magazine**. Duke Kennedy Sweetman Ltd of Dublin and Foxford, Co. Mayo publish it. We will shortly start to take a clearly defined section within each bi-monthly issue of the magazine. It will enable us to report more quickly on things that are happening. It will give us a much-increased circulation around Ireland and widen our readership. The current ES2k magazine style will not change. At first each issue will include around 8 pages.

I am confident this is another step up for ES2k and its mission. It will enable us to exert more influence in the development of earth science in Ireland. Currently our membership is touching 500, remarkable for such a young group in Ireland. I urge all members to follow us across to the new magazine. You will, as a member, get the first issue sent free. Thereafter there will be a charge and it is hoped many members will take out a subscription for a year or two – good rates are sure to be on offer. Give it a try please. **You** can make it just the start of a new adventure and not 'the beginning of the end'. That goes for my faithful authors who I hope will continue to supply the excellent scripts they have for ES2k. Their input is vital. ES2k will still try to highlight, in a way that is accessible for the general public, the excellent work that is being carried out by our schools, universities, businesses and government departments. We will range all across the island in an effort to show how conservation and the economy are benefiting from earth science. **PLEASE FOLLOW US.**

Do you mind us passing your address on to the *Science Spin* Publishers? We need to do so if you are to get the first free issue. If you object please email: secretary@es2k.org.uk or me at: rbazley@btinternet.com or write to: Editor, ES2k, 19 Inishanier, Killinchy, Newtownards, Co. Down BT23 6SU.

A word about our Printer, **Dorman and Sons Ltd**. All the staff helping me to put this magazine together have been excellent in every way. If you have a printing job to do this is the first place to try. I especially appreciate the work of **Peter Mahaffey**, the company IT expert, who has created the magazine design we have put before you over the last five years. He has a family member who is a geologist, and it shows. *Thank you Peter.*

Finally, **a big thank you** to all our sponsors, advertisers and supporters over the past 6 years. I hope we have given you good value. Certainly we could not have got this far without you. If you want to continue to support us please contact me.

Contributions, please, for the next issue in *Science Spin* to the Editor or the Regional Correspondents - for **Connacht** 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 the contributors in this issue.

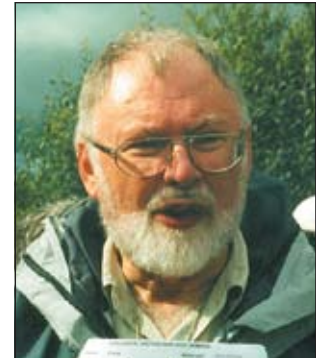
Acknowledgements

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Chairman's COLUMN



ES2k Chairman, Philip Doughty

In May 1861 360 people gathered in the Music Hall in Belfast to hear the first of 9 lectures on geology, the spanking new, fashionable and seductive science, to be given by **Joseph Beete Jukes**, the Director of the Geological Survey of Ireland. His lectures broke all records. Indeed the lectures continued so much in demand that eventually Ralph Tate was appointed full-time tutor based in Belfast. It was he and a small body of determined enthusiasts who founded the Belfast Naturalists' Field Club in 1863.

The tapping of this new public released a torrent of talent readily exemplified by Tate's students. The Field Club not only provided a focus for activity but through its *Proceedings*, offered the ideal medium for the publication of its original amateur research. Its geological ranks included such people as William

Earth Science 2000

Raising awareness of Earth Science across Ireland

Chairperson: Philip Doughty; Secretary: Kirstin Lemon, email: secretary@es2k.org.uk;

Treasurer; Joanne Curry; Committee: Tony Bazley, Peter Crowther (Editor Website), David Kirk (Publicity Coordinator); Co-opted: Bernard Anderson, John Arthurs, Marie Cowan, Garth Earls, Ian Enlander, Martin Feely, Bettie Higgs, Paul Lyle, William Lynn, Patrick McKeever, Jenny McKinley, Matthew Parkes, Karen Parks, Sophie Préteselle, Alistair Ruffell.

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Swanston (graptolite specialist); Joseph Wright (a grocer by trade with an international reputation in foraminiferal studies); Sydney Mary Thompson and Mary Andrews who undertook an immense project centred on glacial erratics; Robert Lloyd Praeger (post-glacial estuarine clays); Robert John Welch, the world renowned geological photographer and Robert Bell, a riveter in Harland and Wolfe's shipyard with a legendary nose for the zeolites in the Antrim basalts.

So the once thriving amateur movement made a significant contribution in laying the foundations of Irish regional studies. Nor was this solely a Belfast phenomenon; many other Irish towns benefitted from the lecture programme. Interestingly, Dublin, the home of the great national institutions felt the need less.

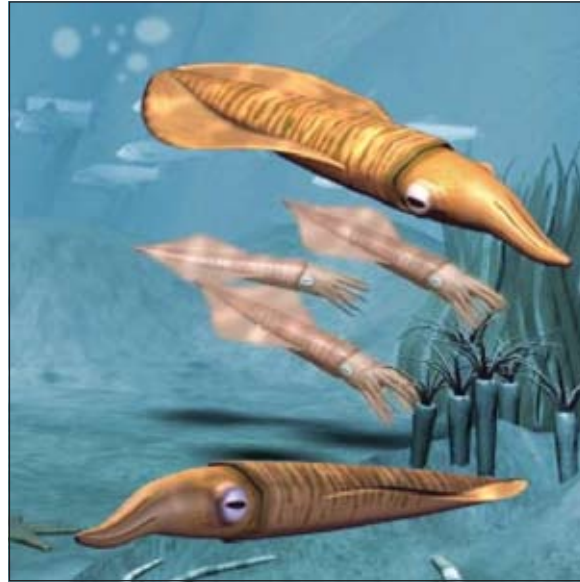
So what happened? Again, the answer is largely historical, associated with the wind-down of the Geological Survey of Ireland on completion of a map series in 1890 and the departure of its staff, an event that affected the whole culture of geology. This and other influences did not prove fatal but the enthusiasm for amateur research dwindled, as the literature of the early 20th century shows.

The last two decades have seen a remarkable shift in voluntary organisations with booming recruitment among retired and active professionals from all walks of life but as yet not reflected in substantial amateur geological projects in Ireland. That is why we think the time is ripe to examine the problems surrounding our heritage of geological sites, particularly the ever-present threat to their integrity and survival. This is an area of geology where 21st century amateurs can make a vital contribution. We intend this year to revisit the possibilities offered by the RIGS (Regionally Important Geological and Geomorphological Sites) scheme that has been so successful in many parts of Britain. We will be looking to all of you, amateur and professional geologists alike, to get involved. Interpretative and educational literature for the best sites will offer an easy way in for school project work and with our increased involvement in Irish Geology Week we have an ideal medium for promotion. If you have any views on the way we should develop RIGS in Ireland do not hesitate to get in touch with me. Also see www.ukrigs.org.uk.

Philip Doughty

BELEMNITES

Belemnites were marine animals that lived from, roughly, 300 million - 40 million years ago. They were most numerous in the oceans of the Jurassic and Cretaceous Periods. These large



molluscs are related to and resembled present day squids. The name comes from the Greek *belemnion* meaning 'a dart' or 'a javelin' because of the shape of the hard part, the **guard**. This is the bit, composed of calcite, which is usually found preserved in rock as a fossil. The rest of the animal was made of soft tissue that rarely survived fossilisation. The guard lay towards the back of the animal's body with its point facing backwards. At the front of the guard there was usually a conical-shaped cavity, **alveolus**, which contained a chambered structure called a **phragmocone**. The latter was gas-filled to control the underwater buoyancy of the animal.

In life, comparing them with squids, they would have been able to swim backwards or forwards and, further, in two different ways, by jet-propulsion and by fin-propulsion. The jet-propulsion, useful for escaping predators, was achieved by shooting water out of a bladder-like structure called a hyponome. This same structure would have also shot out a black liquid (like ink) designed to confuse a predator. Cuttlefish, octopus and squid use the same defensive mechanism in today's oceans. Belemnite

fossils have been found with ink-sacs preserved but not, to date, in Ireland. Fin-propulsion was employed for slow swimming.

You can find belemnite fossils in the Cretaceous rocks, especially the Chalk, of the north of Ireland. In fact, if you examine any Chalk there is a good chance that you will see one of the dart-like guards or, at least, its cross section that looks like a ring of calcite, often with the calcite as radial-shaped crystals. We don't recommend trying to collect them from the hard Chalk but you might find one in loose scree. The shape of the guard varies from thick to thin and long to stubby. These characteristics allow determination of the various species that in turn can help date or correlate rocks from

place to place.

Why are these fossils hard to find in the south of Ireland? Hardly any rocks of Jurassic and Cretaceous age are found on land. Have a look at the maps of Ireland's rocks and you will see this is the reason.

Patrick Gaffikin



Cover photograph

16,000 BC (?) – the scene somewhere between Wicklow, Cork and Tralee.
Photo Courtesy: Neil Ross, Cardiff University.

See 'Pingos' article

BUNDORAN IDEAL FOR SCHOOLS

The coastline around Bundoran on the south side of Donegal Bay is an excellent locality for geological fieldwork. **It is suitable for all age groups of pupils from Key Stage 3 to A level.** All the best



sites are easily accessed from the town, but it is important to check tides and weather forecast before embarking on fieldwork, since the east side of the bay is inaccessible at high tide or during stormy weather when there is a large surf. A map will show the main street of the town with the shore and the rocky wave-cut platforms adjacent to it. There are two excellent and accessible localities, the West End around the Bathing Pool and the Rougey Strand at Aughrus Head in the east..

The rocks in the area are Carboniferous, chiefly limestones and black shales. The massive limestone beds which are horizontal or gently dipping form extensive wave-cut platforms backed by cliffs of less resistant shale which are overlain by boulder clay (till) of variable thickness. The limestones and some of the shales are highly fossiliferous which makes a range of investigations possible. Other studies can be based on joint patterns and tectonic structures such as faults.

The West End / Bathing Pool - To reach this locality, drive west through the town across Bundoran Bridge and turn right down the small *cul de sac* leading to the bathing pool and the cliff top path. There is space to park here and the rocks below the cliffs adjacent to the natural pool can be reached by steps that descend the cliff. Here there is an excellent section through the cliff.

This section from the limestone platform ranges upwards through finely laminated black shales, a resistant limestone band, more shales and finally boulder clay,

which is clearly visible here. The limestone platform forms a safe and accessible zone for a range of studies based on joint patterns and contained fossils. A good range of fossils can be found and identified, including solitary and colonial corals and several species of brachiopod. Apart from identification, it is possible to conduct some quantitative exercises using a **quadrat**.

Walking westwards along the platform it becomes obvious that the main structure is a gentle syncline



plunging south beneath the shale cliffs. A minor fault trending north/south can be seen in the centre of the syncline as a narrow gully cutting across the platform and displacement of the limestone band in the cliff. Continuing west a second set of steps gives access back to the cliff top path and a return route to the starting point.

The Rougey Strand at Aughrus Head

- There is a large public car park at the main beach but a height barrier makes this accessible for cars only. If the group is using a minibus, it will be necessary to park further back from the coast or use the large car park at the Great Northern Hotel on the cliffs at Aughrus Hill. From here there is a pedestrian path across the golf course to the cliff top path and wooden steps leading

down to the beach. Walking from the shelter house at the east side of the beach the first cliffs exposed are composed of boulder clay that is being eroded at high water level.

It affords an opportunity to examine the composition of the **boulder clay** and possibly identify some of the larger clasts contained within it. The boulder clay rises in the cliffs and gives way to inter-bedded limestones and crinoidal shales. To the left of the wooden steps leading up to the shelter house on the cliff top there is a good vertical section through this sequence of rocks which can be measured and recorded on a graphic log sheet. To the right of the same steps, a small stream and waterfall has produced a spectacular outcrop of tufa and where the

rocks overhang, some small **straw stalactites** can be seen forming. By climbing the first flight of wooden steps a vantage point is reached looking north-west down the gully of the Rougey Strand. This has been formed by the differential erosion of the less resistant crinoidal shales which are sandwiched between more resistant beds of limestone above and below. The whole

sequence dips about 30 degrees south-west. If tide and wave conditions are favourable, it is possible to proceed along the rocks to the west of the Rougey Strand. Here there is an **excellent range of fossils** including corals, brachiopods and crinoids. Some correlation exercises can be carried out by comparing the fossil ranges here with those on the west side of the bay. It is also worth noting that for the most part



the corals and brachiopods are confined to the limestones and the crinoids to the shales prompting a range of hypotheses based on palaeoenvironments and energy levels at the time of deposition. A very good example of **a normal fault** can be found in the cliff about half way along this section. Pupils can record the details of this and measure displacement using suitable marker beds.

Where time permits **a third location** can be visited by returning to Bundoran Bridge and descending to **the small beach below the Tourist Information Office**. Here fossils are exposed on the flat rocks but unfortunately some interesting sections in the cliffs here have now been obscured by the new and essential coastal defences.

Accommodation in the numerous hotels and B & Bs is inexpensive outside the holiday season. Most of these are open all year and will give favourable group rates. Fieldwork in Bundoran can be combined with study in other localities around Donegal Bay such as Mullaghmore and Streedagh to the south-west and St John's Point and Muckros Head on the north side of the bay. It is also a suitable base for visits to County Fermanagh and the Marble Arch Caves.

William Lynn,
Foyle & Londonderry College

TELLUS



Tellus plane at Newtownards Airport, its base for this year's work

Probably the most significant project in Northern Ireland since the days of drilling deep boreholes about 50 years ago. It has the potential to help the economy and our health. Tellus leads Ireland and Great Britain with its advanced technology. ES2k will be following progress with great interest. An instrument-laden aeroplane from the Geological Survey of Finland has been low flying the western part of the country and, on the ground, surveys of the chemicals in soils and streams have been taking place. So far, we learn, about 60% of Northern Ireland has been completed. The remainder, roughly the area east of a line drawn between Coleraine and Newry, will be done next year. Then comes the analysis of what the data collected all means. So, as they say, *watch this space*.

Editor

Department of Geology



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**University of
Leicester**

So one day this rock says to me . . .

Do you like rock music mainly because it's called 'rock' music?

Do you keep stones in your room as pets?

Do you appreciate the joke in the song title 'I'm gonna take a sedimental journey . . .'?

You do? Congratulations – you've the makings of a geologist! All you have to do is keep looking around you, keep asking Why? and open yourself to the 'Wow' factor as you see a story in every landscape, every stone. You'll soon realise little old planet Earth is just the most interesting show in town.

It could be the beginning of a career that takes you to the most exciting places in the world, or even a lifetime of fun as an amateur enthusiast. Just think, somewhere in Dublin or Belfast there could be an accountant living in frustration or a girl wasting her life in marketing who, if their spark of interest had been



Ask "Where"?

fanned into flame, could have been the one to go down in history for, say, discovering the code for predicting earthquakes. *And don't be embarrassed; there are venerable ones with more letters than they can count behind their name who still give pet rocks they've had for decades a sneaky stroke.*

Make no mistake, **geology can be an addiction.** Give some people a gravel driveway and they'll be quiet for hours examining individual bits. Some see being a geologist more like being in a Holy Order than being just a mere scientist (an order, however, where beer seems to be an essential part of many rituals!) but they are fun guys; they even make geo-jokes: '*Why are geologists unpopular – Because they're fault-finders.*'

And of course they are pure of mind – a

geologist would *never* think that the Moine Thrust was something from the Kama Sutra.

Scientific success may well be 10 per cent inspiration and 90 per cent perspiration but the path to it starts off - and perhaps more so in earth science than most others - with a sense of wonder. And there is no science more full of wonder



Ask "What"?

than the study of the rocks beneath us and the aeons of teeming life they have borne, and in some cases were created from. This belief underpins the approach by ES2k in its efforts to encourage young people to wake up to and find inspiration in the landscapes around them and to want to know more of the story they tell. If even for a few individuals it turns their life towards an earth science profession the effort will be worthwhile - for them, for us and **for our island economy**, because generally people don't realise the enormous contribution practical geology makes.

Wonder at the artistry in rock sculpted by the elements, the patterns and textures of rounded pebbles on a storm beach, a youthful climber's moment of intimacy



Ask "What"?

What lit YOUR fire?

ES2k would like to hear people's stories of how they caught the 'geo-bug' and where it took them. Whether you are a successful professional or an enthusiast, teenager or pensioner, drop us a few lines with your name and position and we'll include them in a future article. You can send them to the editor or Email to davidkirk@ntlworld.com

with ‘the good grey rock that loves the grasping hand’, the chancing upon of a fossil, a fragment of preserved-for-ever ancient life, an inspirational book casually picked up or an enthusiastic teacher, the awesomeness of Crunchtime for Continents - *much cooler than ‘plate tectonics’!* . . .

How many of Ireland’s earth scientists, now enjoying successful and challenging careers in one or another of its many facets, or its many gifted amateurs, can remember the moment, the event, that first fired their young imagination and sparked their interest in geology?

Take a hundred geologists and you’ll probably have a hundred different moments that set them on their way. Some seem to have cut their first teeth on bits of stone, others were steered by later events. The following are responses to our question in Issue 11 – ‘How did you catch the ‘geo-bug’?

Take **Philip Doughty**, ES2k’s Chairman, formerly Head of Science at the Ulster Museum and a stimulating speaker brimming with infectious enthusiasm. He got hooked when he was only about six, his young mind fascinated by ‘treasures’ as he called them, exquisite fossils given to him by men who worked in the coal-mines of his native Yorkshire, and spellbound by stories of whole tree trunks standing upright among the deep coal seams. Teenage years walking and exploring the great limestone landscapes of Yorkshire and then discovering the challenges and companionship of the cliff-faces confirmed for

him the fascination of rock.

“When your life can depend on a toe or fingernail purchase on the rock indenting your cheek there is a tendency to take more than passing interest in it,” he recalls

Philip’s youthful interest was transformed into a lifetime’s dedication to his science by the influence of a talented teacher, under whose ‘concerned tutelage’ he says, ‘the landscape began to make sense’. Arthur Holmes’s *Principles of Physical Geology* became his Bible and ‘***I never looked back***’.

Then there is **Graham Andrews** who writes: I am finalising my PhD thesis at the University of Leicester. Currently, I am examining volcanic deposits from a precursor to the famous Yellowstone Caldera.

I have always been interested the geology and the great outdoors; in particular the rocks along the shore of Belfast Lough where I grew up, the Giant’s Causeway and the Mourne Mountains. I did my first academic geology as part of GCSE Geography and that inspired me to take Geology as an A-level at **Regent House Grammar School, Newtownards**. I will always be indebted to my teachers, **Miss Loney and Mr Lipsett**, for the fantastic course we studied which included residential trips to north Donegal and north Antrim. It inspired me to continue geology at university and I chose Leicester because of its emphasise on fieldwork and the friendly atmosphere. I started

in October 2000 and after four years graduated with an MGeol degree; in that time I visited every corner of the UK and many places beyond. My third and fourth years set me on my present career when I took up volcanology and completed my first real research project on the igneous and metamorphic history of an Archean intrusion in Sutherland. Upon graduating in July 2004 I headed to New Mexico to take part in a four-week volcanology training camp. It was at this stage I decided I wanted to continue and become a volcanologist and keep topping up my tan.

I have been lucky enough to attend conferences in France, Utah and California, and been on field trips in British Columbia, Arizona, Nevada, Illinois, Gran Canaria: anyone who likes to travel should consider volcanology! Hopefully, Mexico, Iceland and Hawaii will be on my itinerary soon.

For **Matthew Parkes** of the Geological Survey of Ireland and, now, the National Museum of Ireland, it was a holiday with his father on the Dorset coast at the age of seven or eight that ‘lit his fire’.

“A day spent of glorious sunshine splitting shale blocks and releasing glorious ammonite fossils with their multicoloured

lustre into the light, and then wrapping the prizes carefully in newspaper”, was the start of his lifetime’s interest and a successful career. Important too was the deductive reasoning instilled in him there by his father - the matching up lithologies with particular ammonites, and seeing the fabulous landslips and how the different beds were perturbed into giving up their treasures.

Peter Crowther, Keeper of Geology and now Acting Head of Science at the Ulster Museum, tells us that the seeds of his life’s work were sown in family drives and walks in the landscapes of North Wales and his wonder, as a child, in HOW such dramatic panoramas came about.

Again, an enthusiastic teacher at O-levels fuelled his young interest with passion and field trips but there was no provision at A-level so it was Maths and Physics for Peter as he went on

to Cambridge with thoughts of a Computer Sciences degree. However his luck was in; geology was a first year option. He took it - and became permanently hooked through a combination of an inspirational tutor and the excitement of the new plate tectonic – sorry, *crunchtime for continents* - revolution.

“***I never gave computers another thought***”, he says - although that couldn’t be quite true: Peter now runs ES2k’s excellent website.

So this was how just four of Ireland’s geologists became hooked on the fascination of the earth sciences. There are many other stories out there.

David Kirk

PEOPLE ON THE MOVE



Sonja Masterson has recently left Minerex Environmental Ltd to join the Geological Survey of Ireland where she is working on the Groundwater Protection Scheme for County Cavan. She will be known to many readers as the Education and Outreach Officer of the Irish Group of the International Association of Hydrogeologists. Sonja is organising school and public outreach events focussed on groundwater, a vital resource for us all. We wish her well with the new work at GSI.

Matthew Parkes, ES2k's own Leinster correspondent, has now left the Geological Survey of Ireland and joined the National Museum of Ireland, Natural History Division. As Assistant Keeper responsible for Earth Science, he will be curating important national collections, dealing with geological enquiries and promoting earth science through outreach activities and exhibitions. With a new building planned for the Museum's Collins Barracks site, which will include a new Earth Science Gallery, Matthew has a busy time ahead. As one of the hardest and most reliable workers for ES2k we hope he will still find some time for us. Good fortune Matthew, you deserve it.

MOVING IN

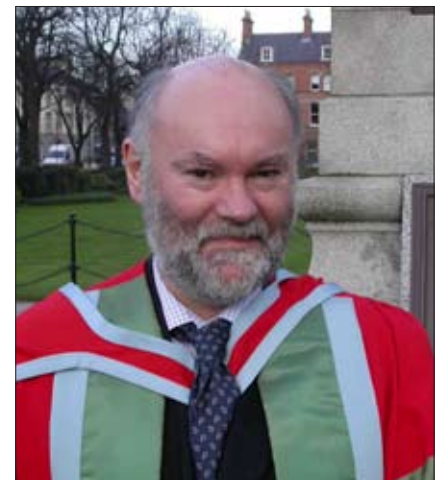
Newly elected at the October ES2k Annual General Meeting are **Kirstin Lemon** (Hon. Secretary) and **Joanne Curran** (Hon. Treasurer). We welcome them and in doing so thank more than we can say the respectively outgoing Marie Cowan and Jenny McKinley. Editor

MOVING UP

We were very pleased to see **Professor David Harper** from Copenhagen move up a degree to gain the very prestigious award of D.Sc (Doctor of Sciences) on Friday 16th of December. This award is the first geology degree (higher or

lower) since the closure of the Geology Department some five years ago. Many ES2k readers know Dave from his recent time as lecturer at the National University of Ireland, Galway, which he was sad to leave in 1998. Some of the 'more established' members of the geological community will also know of Dave from his time as a Ph.D student working with Tony Wright in the Geology Department.

David was the first higher science degree award to be made on the day, sharing the stage momentarily with our honorary graduand professor of the day, Lord Melvin Bragg.



David now works in the Geological Museum, University of Copenhagen. His original Ph.D research at Queen's on Upper Ordovician brachiopods from the classic Girvan district has now expanded worldwide and to the whole Lower Palaeozoic. This work concentrates on Greenland faunas and has taken David to China, Russia and his work on Tertiary brachiopods has taken him to many of the Caribbean islands.

Alastair Ruffell, School of Geography, Archaeology & Palaeoecology, Queen's University, Belfast



Some members of the ES2k Committee at a meeting in Dundalk with Matthew at the back. Others, l to r, Tony Bazley (Editor), Ian Enlander, Paul Lyle, Jenny McKinley (Treasurer), Philip Doughty (Chairman). Photo taken by David Kirk.

LUCKY STRIKE

We hear that at a mining conference the lucky winner of a one-carat brilliant cut Canadian diamond valued at \$15,000 was Alistair McCready of the Saskatchewan Research Council. Alistair is a Queen's University, Belfast, geology graduate and a former research student of John Parnell.

ROCKS FOR SCHOOLS

This project, to make and distribute a set of rock samples for each of the 850 schools that teach Leaving Certificate Geography was the inspiration of *Ian Sanders* of the Geology Department of *Trinity College Dublin*. Of course Ian had done this before with the IGA rock sets, but this time he went for comprehensive coverage of schools and a far more ambitious scale of operation. Hiring a van and recruiting the help of TCD postgraduates and students over the summer he accumulated the enormous volume of rock needed to create the sets. The rock sets are simple – *six labelled basic rock types*, in large enough pieces to really give a feel of what they are like, accompanied by an excellent booklet as a resource for the teacher. The package is tailored to support the Geography curriculum.



Pictured l to r: Fatchna O' Reilly, Financial Director, Whelan Quarries; Professor John Hegarty, Provost of Trinity College, Ian Sanders, Breda Whelan, Management Accountant, Whelan Quarries, and Dr Barry McSweeney, Chief Scientific Adviser to the Irish Government

The rock set project for schools was launched by **Barry McSweeney**, Chief Science Adviser to the Government, in the Museum Building, Trinity College on Wednesday 28th September. The many people and organisations that helped Ian were of course duly acknowledged but particular thanks were expressed to **Whelans Group**, based in Ennis, County Clare. It generously offered sponsorship for the project when first approached about providing the limestone samples. The rock sets are being distributed to teachers through the Blackrock Education Centre and in service training programmes.

Matthew Parkes

ES2k congratulates Ian Sanders and all involved in this very worthwhile effort. Now for Northern Ireland schools?



Evolution sucks!

There's a dog
on the Burren's Flaggy Shore
or maybe it's a dinosaur;
hard to tell.

Rooted to the spot
staring out to sea
thinking long
of what might have been.

Is his like what might have been -
a dino-dog,
but flesh and bone
not stone,
had the corals
and the crinoids
from which he's built
done better in
the Darwinian race?

Memories in the old stone stir:
'Come on you polyps'
he hears again
the coral calling
across the deep sea-bed.
'Let's make waves
in the gene-pool;
get us an evolutionary edge
on those smart-ass ammonoids
jetting about above.
Some day we could run the show'

But it was not to be;
corals never made the grade.
now the dino-dog,
smooth coat fossil-marked,
shaped by time and tide,
not evolution,
wonders why it all went wrong
and thinks -
evolution sucks!

David Kirk

POP IDOL OF SCIENCE

FameLab was launched to find a new generation of communicators of science. One of the heats was in Belfast and we don't know how many of our readers entered. But we do know one. Marie Cowan, our Secretary at the time. It is important that earth scientists get involved in presenting their subject and we applaud Marie for having a go. We know she has excellent presentational skills and she made it to the second round.

The winner was Mark Lewney, a patent examiner from Newport, South Wales. The good news for us is that there were two runners-up with the best credentials, David Booth, an evolutionary biologist from Queen's University, Belfast and Matt Wilkinson, a pterodactyl expert from Cambridge. So someone from Ireland and an earth scientist were beaten by a 'loony'.
(Sorry, couldn't resist it. Editor)

IRELAND, SHAKEN BUT NOT STIRRED

We were all shattered emotionally by the devastation and suffering wreaked by the Asian tsunami at the end of 2004, but most readers will not be aware that the earthquake which caused the sea waves was also shaking the ground and creating distinct oscillations on water levels in aquifers in Ireland. This article tries to explain the phenomenon, which may not yet be fully understood by seismologists, whereby enough energy can be transmitted around the world to make the water table oscillate in particular places.

In the early 1950s, one Elmer Rexin (of a shoe company in Milwaukee) recorded earthquake effects for several years in a well at his company site. He speeded up his water level recorder and observed fluctuations in the well that resembled long-period seismograms. Then, in 1964, a massive earthquake in Alaska triggered so many reports of the phenomenon that the US Geological Survey collated data from 1,450 wells in North America and from others as far away as the Phillipines, Africa and Australia. The water level in one well in Florida fluctuated by just over 5 metres, which is quite amazing- *even allowing for everything being bigger in the US of A!*

The first recognition of similar effects here seems to have been in 1985, when I was working in the Geological Survey of NI, and was glancing through recently retrieved charts from some water level recorders on observation boreholes in the Sherwood Sandstone of the Lagan Valley. Unusual, small blips on the paper traces from two boreholes at

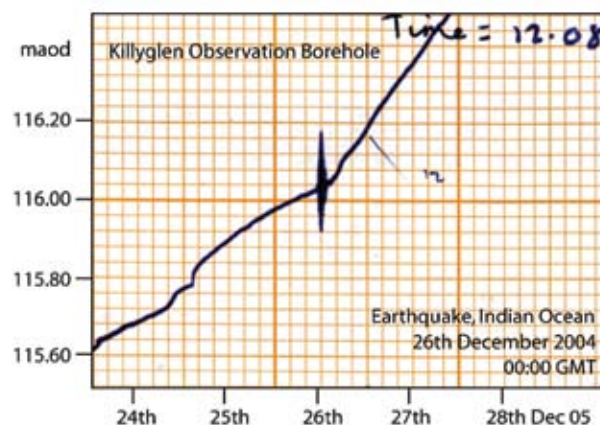
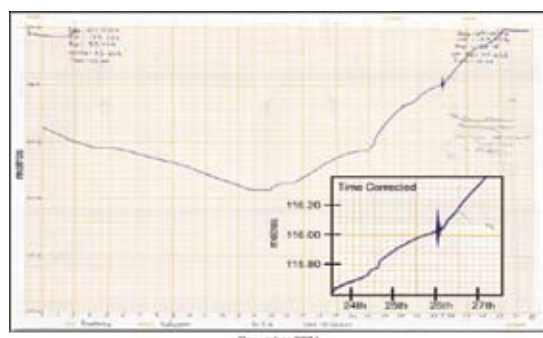
Dixon Park and Glenburn (Dunmurry) caught my eye and further examination showed that they occurred at exactly the same time on 19 September and represented 1.8 and 4.2 cm of vertical water movement, respectively. Perusal of charts from the few other sites, which were being continuously monitored over the same period, revealed a much bigger movement of 12.8 cm in a Chalk borehole at **Killyglen, near Larne**: this was followed two days later by a lesser event of 4.8 cm magnitude. The water table in this borehole is a long way below ground level, ranging between 20 and 30 m depth roughly, according to season, but we are also fortunate to know (from CCTV logging of the hole after drilling) that the groundwater occurs in wide fissures. There are also streams in the vicinity that sink into the fissured Chalk and rise again in various places.

Suspicious that **these events corresponded to a major 8.1 magnitude earthquake**, which had devastated large areas of Mexico City, and a large 7.6 aftershock, were confirmed by colleagues in the Global Seismology Research Group of the British Geological Survey in Edinburgh who regularly received reports of similar effects in Chalk boreholes from the south of England. They also supplied USGS data on major earthquakes, of magnitude 6.5 or greater, throughout the world over several years, so that they could be compared with our local groundwater level charts. In the period between August 1983 and November 1986, the Killyglen water level reacted to no less than 20 recognised earthquakes,

ranging in magnitude from 6.7 to 8.1. The epicentres were located in all the seismologically unstable zones of the world, including the Aegean Sea, North and South America, Japan, the Mid-Atlantic Ridge, Indonesia and Taiwan, and Fiji, as well as Mexico already mentioned. The largest observed fluctuation was 16.1 cm from a 7.7 magnitude source in Taiwan in November 1986. Small responses were also recognised in four different Sherwood Sandstone boreholes in the Dunmurry - Lisburn area on a few occasions, while a 7.0 cm response was belatedly identified in a Permian Sandstone borehole at Comber from 1979.

Some background reading suggested that the groundwater effects might be accompanied by the creation of surface waves, or **seiches**, on large surface water bodies so continuous water level recordings of Upper and Lower Loughs Erne and Lough Neagh were also examined but no effects were identified.

Jumping forward in time, **Peter McConvey of GSI and Colin Gibney of EHS** have recognised the response at Killyglen to the **Asian tsunami 'quake of 26 December 2004** which, with a magnitude of 9.2 on the Richter scale, produced a startling rise and fall totalling **26 cm**. **Geoff Wright**, of the Groundwater Unit in the Geological Survey of Ireland, has also identified effects from this event at three sites in Co. Kilkenny and one in Co. Roscommon – see GSI News, Issue No.2, available on the GSI website at www.gsi.ie. Of these, one borehole is in Quaternary



Killyglen, Larne. Waterlevel chart at time of the **Asian Tsunami**. Reproduced courtesy of Peter McConvey, GSI and the Environment & Heritage Service.

gravel, two in limestone, and one in sandstone. Peter McConvey tells me that he has also picked up a response in the Killyglen borehole to the disastrous October 2005 earthquake in *Kashmir* but apparently with no evidence of the large aftershocks.

The following complicated bit is italicized for non-scientific readers. To read or not to read?

*So how is the earthquake (seismic) energy actually converted into the moving water that we have been recording? It seems water wells respond to earthquakes either **dynamically** or **statically**. For convenience, we can dismiss the **static** response because this mechanism could not explain what we are observing in Ireland.*

The **dynamic** response is fluctuation due to long-period surface waves, also known as Rayleigh waves, which propagate outwards from earthquake origins (epicentres) and travel round the earth with a velocity of around 3 km/s, period typically 15 to 40 seconds and, in the case of the 1985 Mexican event, a maximum amplitude approaching 2mm in solid rock in Ireland. These waves cause temporary volume changes in the rock as they pass by, and a volume change in an aquifer produces a pressure change in the water. The water level in an open observation well will go up and down in an attempt to balance pressure fluctuations in the aquifer.

In the case of a confined aquifer,¹ an observation well acts like a simple manometer, with the height and weight of the water column equaling the pressure in the aquifer it penetrates. A sudden change of pressure in the aquifer makes water flow into or out of the well until the height of the water column again balances the aquifer pressure. In these circumstances only very small responses, if any, would be expected, and this proves to be the case with our Permian and Triassic Sandstone aquifers, which are all confined with only some sites showing any response.

¹ A confined aquifer is one which is completely saturated with water and sealed by an overlying impermeable stratum such as shale, mudstone or till. Unlike an unconfined aquifer, which has a free water table within it, the water in a confined aquifer is held under pressure, and its level is a pressure surface either within or above the confining stratum. If a borehole is drilled into a confined aquifer, the water encountered will rise to the pressure surface level.



Manually checking water level in a well. Photo courtesy Peter McConvey, GSNI

*It has been shown in America that open unconfined wells, subjected to Rayleigh waves of the frequency we are dealing with, can behave like **simple harmonic oscillators** (SHOs). School physics taught that SHOs can be overdamped or underdamped. This is important because, when disturbed, underdamped oscillators will still move back and forth, whereas overdamped ones do not oscillate but simply return (with an exponential motion) to their original resting place. Now, when a water well behaves as an SHO the oscillating mass is provided by the height of the water column in the well while damping depends on the ease with which water can move in and out, which in turn is determined by the permeability of the aquifer formation.*

Water moves readily in and out of a highly permeable well and if the permeability is high enough, the well behaves like an underdamped oscillator. If permeability is low, water cannot move in and out easily; the well is overdamped and oscillation is smaller than the pressure head fluctuation in the aquifer. In very tight (less permeable) formations, wells may not respond at all.

Coming back to our local context, it would be difficult to find a more permeable formation than the Chalk at Killyglen. So the remarkable fluctuations that occurred at Killyglen are probably due not only to direct action by the Rayleigh waves, but are also enhanced by underdamping in the well itself.

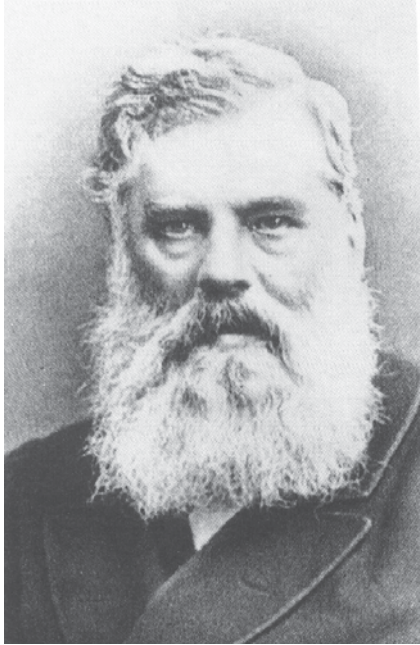
It is now clear that remarkable phenomena are being recorded here, **so**

could they be used for any useful purpose? US seismologists have been experimenting for many years in a desperate search for ways to predict earthquakes so that some of their worst impacts on humans can be mitigated. They have had some success with the static response of water wells, using them as strain meters, but have found little of interest in the dynamic response. The strain meter work also offers possibilities in engineering geology and rock mechanics. I can envisage little hydrogeological information that could be derived, except for one possibility of marginal usefulness. Since all our solid rock aquifers are dominated by their water flowing through fissures, as opposed to through the rock matrix, I would expect earthquake waves arriving at right angles to the main orientation of the fissure systems to have greater effects than ones travelling along the fissures. Such orientations cannot usually be determined cost-effectively during hydrogeological investigations, so perhaps an M.Sc. student could compare the responses to earthquakes from all over the world, allowing for the effect of distance from the source, and there should be enough data available now for a worthwhile project.

In the meantime, it would be interesting to speed up the chart recorder at Killyglen and show the separate oscillations instead of having them superimposed in one event.

Peter Bennett, White Young Green Environmental

IRISH 'ROCK STARS'



Thomas Oldham
(1816–1878)

The town of Bray, which during Victorian times was a thriving holiday resort, is situated nearly fifteen miles south of Dublin. The Promenade runs parallel to the shoreline, and today as in the past, day-trippers and other longer-term visitors walk southwards along it towards the impressive promontory of Bray Head. This headland, which rises out of the Irish Sea and resembles an upturned rowing boat, is composed of Cambrian shales and greywacke sandstones in which are also found resistant quartzite beds.

In 1840 a young geologist by the name of Thomas Oldham discovered odd-looking radiating and fan-shaped impressions in the shales but waited four years until he exhibited them to a meeting of the Geological Society of Dublin. He then showed them to the English palaeontologist Edward Forbes, who gave them the name *Oldhamia* in his honour. Forbes declared that they were “bryozoans” and further named the radiating traces *Oldhamia radiata* and the fan-shaped marks *Oldhamia antiqua*. Later others ascribed them to a bewildering array of plant and animal affinities, but it is sufficient to regard

them as trace fossils of unknown origins. ***For many years these fossils were considered to be the oldest on Earth.***

Who was Thomas Oldham? Born in Dublin in 1836, he was educated at Trinity College, and later at the University of Edinburgh where he studied civil engineering but also attended the lectures of the geologist Robert Jameson. Oldham returned to Ireland in 1838 and joined the Ordnance Survey team as chief assistant under Joseph Ellison Portlock who was examining the geology of Londonderry and parts of adjacent counties. Portlock was clearly impressed and helped by the young man, as he states in the introduction to his 1843 geological report of the district: “whenever I have required his aid ... I have found him possessed of the highest intelligence and the most unbounded zeal”. Oldham was then appointed as Curator to the Geological Society of Dublin, and in 1845 succeeded John Phillips, nephew of William Smith, in the Chair of Geology at Trinity College, Dublin. The following year he was asked to head up the Irish Branch of the fledgling Geological Survey – Phillips had wanted this position but was not appointed and so had returned to England.

Immediately Oldham initiated a programme of geological mapping initially at a scale of six inches to the mile – fortuitously base-maps at this scale were available for the whole country; they were not available to those surveying Britain. The first maps published by the Geological Survey of Ireland were county maps; the first three were Wicklow 1848, Carlow 1849, and Kildare 1849, but by 1857 the now familiar one-inch to the mile map series was established.

In 1850 he married Louisa Matilda Dixon of Liverpool, and although he was drawing two salaries he felt that he would be unable to support his future family. That November he resigned his Dublin positions when he was offered the post as first Superintendent of the Geological Survey of India. This was

to mark the start of a migration of Irish geologists to the sub-Continent. His own brother Charles followed him; as did William King, son of the Professor of Geology at Queen’s College, Galway; Valentine Ball, who later returned to the Chair of Geology at Trinity; and at least 12 other Irish geologists.

In India Oldham oversaw an ambitious mapping programme that initially focused on the coal-bearing successions, and he found time himself to contribute sixteen papers on the topic. A number of Irish geologists made major discoveries in India that continue to have bearings on modern-day geology. Henry Benedict Medlicott coined the term “Gondwana Series” in 1872 while Oldham’s son Richard Dixon Oldham distinguished three types of pressure produced by earthquakes: now known as P (compressional), S (shear), and L (Love)-waves, based on his observations made after the Great Assam Earthquake of 1897. In 1906 Richard showed from arrival patterns of waves from various earthquakes that the Earth had a core, which he thought was liquid in nature.



Oldhamia antiqua
(Geological Museum, TCD)

On the grounds of poor health Thomas Oldham resigned his Indian position in 1876 and retired to Rugby in England where he died on 17th July 1878. He received many honours in recognition of his work, including a gold medal from the Emperor of Austria in 1873, and the Royal Medal from the Royal Society in 1875, but these pale into insignificance when one remembers that his name is enshrined in geological literature in the generic name of a small but important Cambrian trace fossil.

Patrick N. Wyse Jackson,
Trinity College, Dublin

PINGO!

Pingos form around the edge of ice sheets where it is truly cold. Imagine the subzero temperatures and biting winds of the Arctic winter. Just look at the photographs. These are pingos seen today within the Arctic Circle. They form as ice-cored hills that develop from the subsurface growth of a lens of ice within the permanently frozen ground (permafrost). When the ice cores melt the mounds collapse leaving crater-like basins with a rampart of sediments around the edge. They are often found in clusters of a dozen or so roughly circular 'ramparted depressions'.



Pingos at Reindalen. Photo: Hanne H. Christiansen, University Centre, Svalbard

'Fossil' pingos from the last Ice Age have been found in Wales and Ireland. So look at the photographs and you can see what conditions were like here up to about 12,000 years ago.

Where do we find pingos in Ireland? The answer is just inland of Wicklow, Wexford, Cork and around to Tralee in County Kerry. This was where the edge of the last ice sheet in Ireland stood long enough for the icy conditions to allow these interesting structures to form.

This short note does not deal with pingos in detail but as in the magazine article mentioned below, hails the pioneering work of **Edward Watson and his wife Sybil** that led to **the pingos of Wales** attaining international status and recognition. Both these researchers were from Northern Ireland and worked at the University of Wales, Aberystwyth. Sybil currently lives outside Belfast with her daughter Barbara, both active members of the Belfast

Geologists' Society and the Belfast Naturalists Field Club.

The landforms were not easy to recognize and it took years of meticulous fieldwork to confirm the structures. Once the pingos formed they degraded and the badly drained central parts filled with lake sediment and peat. These sediments, through the pollen and animal remains they contain, can give important information on the climate during the last 10,000 years.

A team in Wales (Cardiff University and the Countryside Council for Wales) is currently making a full study of the features. It will enable them to be conserved and managed as part of a programme to sustain natural beauty, wildlife and outdoor enjoyment in rural Wales. There are still uncertainties about how some of the landforms originally interpreted as pingos were created.

Progress on the project was reported in the winter 2004-2005 issue (23) of *Earth Heritage*. It is stated that '*The longer this project continues, the more varied the origin of the landforms interpreted by Edward and Sybil Watson as 'pingos' actually appear.*'

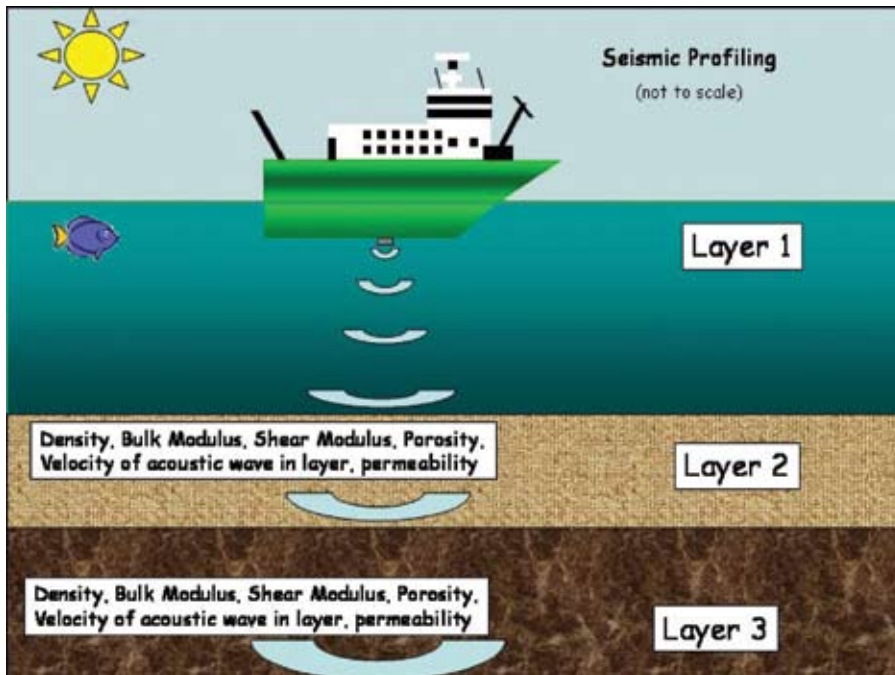
Es2k wonders what work is being done on 'our' (Irish) pingos? Can anyone tell us if work similar to that in Wales is taking place so these fascinating structures can be understood and conserved? Send information please to the editor or Neil.Ross@earth.cf.ac.uk who is part of the Cardiff team.

Editor



Innerhytte pingo in Adventdalen, Svalbard. Photo: Neil Ross

Diving with Neural Nets



The ocean floor is a vast and beautiful place, extending to > 8 km beneath the sea surface. It's near surface has archaeological relics, mineral and energy resources, exotic and largely unknown habitats and undoubtedly many secrets that we have yet to discover. Traditionally, the main way of investigating the sea-bed surface has relied on taking a grab sample or a core deployed from a ship or to send out a diver with a camera. These techniques are not so practical in the deep (> 200m) water beyond our continental margin offshore Ireland. Instead, we rely on ship-borne acoustic ("sound waves") remote sensing instruments that can give us information on the topography (in marine areas called bathymetry) of the ocean floor and its sub-surface sediments. An excellent example of this approach is the Irish National Seabed Survey (INSS), managed by the Geological Survey of Ireland (GSI) in co-operation with the Marine Institute. The INSS encompasses an area that is ~10 times the size of Ireland's land area and represents *one of the largest and advanced seabed mapping projects undertaken anywhere in the world*. It is a first attempt to understand our seabed resources and their potential benefit and at the same time introduce effective measures to protect the marine environment.

But, as Dr. Klaus Leurer of the

Department of Earth and Ocean Sciences in NUI, Galway says 'In order to really understand the connections between seabed sediments and habitats, it has been necessary to develop a theory for how acoustic waves travel through porous sediments – and then check our results with seabed samples and cameras on remotely operated vehicles'.

Seismic Reflection Profiling

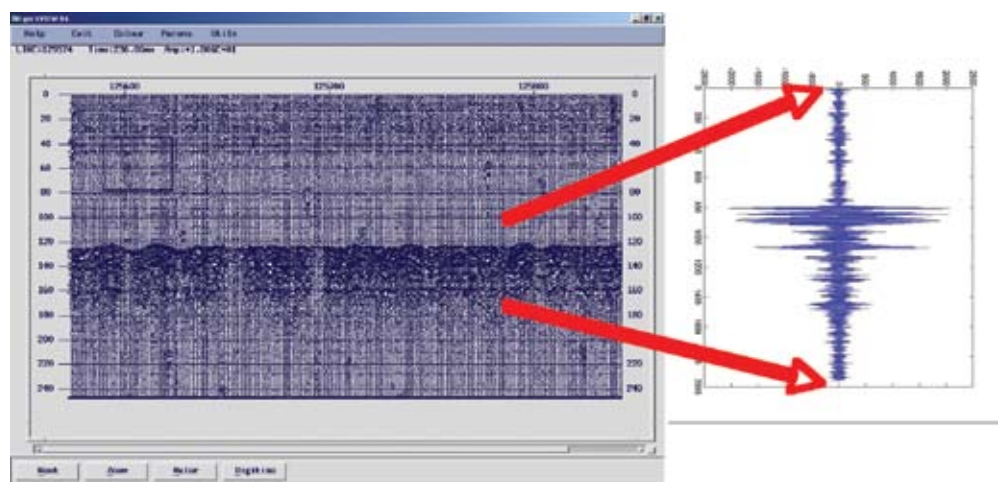
The INSS is primarily a multibeam

acoustic and seismic reflection survey. The multibeam acoustics provides swath bathymetry data covering the entire survey area while the seismic reflection data tells us about the subsurface sediments directly beneath the survey ship. PhD student, Brian O'Connell is working with the INSS seismic reflection data. He summarizes the technique as 'The ship moves along the sea surface and is continually transmitting acoustic pulses that are reflected from the seafloor and subsurface sediment layers, and are received by hydrophones on the vessel'.

'The reflected acoustic signal is received by the research vessel's hydrophone, which converts the acoustic signal to an analog electric current signal that can be filtered, digitized, processed and imported into computer programs for interpretation. By plotting each reflected acoustic signal as a function of time (called a seismic trace) next to the next seismic trace, we can build up a seismic reflection profile that is an image of the sediment layers beneath the ship's track, except the vertical scale is in units of milliseconds, not metres.'

Neural nets

Over the last 2 years, scientists in the Department of Earth and Ocean Sciences at NUI, Galway, have developed something called '*Biot theory*' to model



An example of a seismic profile and seismic trace, with a single seismic trace on the right. It contains information on the acoustic energy as a function of time, increasing vertically downwards. The top of the trace shows small variations in the acoustic amplitude as it travels through water until a large reflection is observed where the energy is reflected off the seafloor and has returned to the receiver. Subsequent reflections are indicative of the different sediment boundaries beneath the seabed. The signal eventually tapers off due to the attenuation of energy as it travels through the sediments. The seismic profile on the left consists of ~ 300 seismic traces, spaced about 1m apart. It shows the variation in the seabed bathymetry at about 125ms. If the water has a speed of sound of ~ 1500m s⁻¹, this corresponds to a seabed depth of ~ 94m.

how acoustic waves interact with soft (porous) marine sediments. As the pioneer of this approach, Dr. Leurer explains, 'If we know in advance about the properties of the sediment layers, such as porosity, density, layer thickness, velocity of acoustic wave, clay and sand compositions etc., we now have the theory to predict what the seismic trace would look like if an acoustic pulse travels through the sediments. The trick is to be able to take one of the INSS seismic traces and analyse it so that we can tell as much as possible about the properties of the sediment layers'. This is Brian O'Connell's PhD research topic. His approach is to use neural networks to recover the physical properties of the

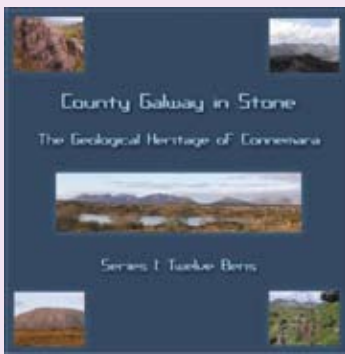
sediments from INSS seismic traces.

Neural networks are processing systems that are inspired by the way biological nervous systems, such as the brain, process information. They are composed of a high number of interconnected processing elements (neurons), working in unison to solve a particular problem. Neural nets, like people, learn by example. A neural net is configured for a specific application, such as pattern recognition or data classification, through a learning process. As Brian explains, 'In our case, a neural network has been trained to recognise the physical properties of different sediment models using synthetic seismic traces

that we have generated from our extended Biot theory. Now we have the ability to divine the physical properties of the seabed sediments from real seismic reflection traces'.

As one of the other NUI, Galway scientists, Dr. Colin Brown comments. '*We will probably still have to use divers, submarines, remotely operated vehicles, etc, but these will be targeted in specific areas to help the calibration of our acoustic techniques*'. Brian O'Connell is more succinct - '*We'll just let our neural nets do most of the diving for us*'.

**Department of Ocean & Earth Sciences,
NUI, Galway**



GALWAY CD - THE TWELVE BENS

A Galway County Heritage project was launched in the Ellis Hall, Letterfrack on 6th September. The cartographer and author Tim Robinson addressed the event.

Galway County in Stone: The Geological Heritage of Connemara – Series 1: Twelve Bens is an offline CD-Rom website that explores the geological evolution of the Connemara landscape from its origin in an offshore marine environment 750 million years ago to the recent glacial activity of the Ice Age 10000 years ago.

The multimedia CD focuses on the Twelve Bens and Inagh Valley region of Connemara and allows viewers to investigate the development of the natural landscape of Connemara with the aid of text, images, animations and an interactive virtual landscape. *The interactive virtual landscape allows viewers to fly around a 3D digital model of the Twelve Bens.*

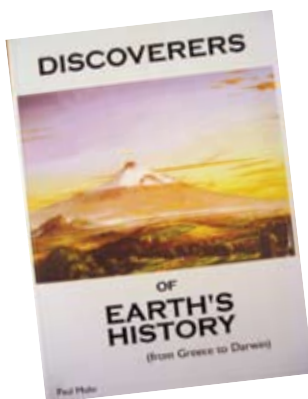
Ronán Hennessy and Martin Feely of the Digital Landscapes Research Group in the Earth and Ocean Sciences Department in NUI Galway developed the CD-Rom. Galway County Council

and the Heritage Council provided funding for the project. Ms Marie Mannion (Galway County Heritage Officer), Mr. Mark Conroy and Ms. Bridin Feeney of IT Department of Galway County Council provided assistance and advice during the course of the project.

The CD-Rom has been made available free of charge to primary and secondary schools throughout County Galway, as well as to public museums, libraries and tourist information offices. It will also be used as teaching material for third level students studying and visiting Connemara. An Irish-version of the CD will be produced, and made available over the Internet.

More information: **Dr Martin Feely**, NUI, Galway, Tel +353 91 492129 Email martin.feely@nuigalway.ie

(An excellent initiative that will be of interest throughout Ireland, Editor)



This new book by **Paul Mohr** is an eclectic collection of brief synopses of views and explanations of the formation of the Earth and various geological concepts defined by a range

Discoverers of Earth's history

(from Greece to Darwin)

of individuals. Mohr starts with his earliest entry of Amennakht, chief scribe to Rameses IV at about 1160 BC, who made a geological map on papyrus with different colour washes for different rocks, metalliferous lodes and dots for coarse alluvium.

Meandering through time up to Darwin, the entries are largely before geology became established as a mainstream science. Someone familiar with basic geology will perhaps get more out of reading some of the weird and wonderful

ideas which are summarised, but it is not necessary to enjoy delving into the book. An index is provided of the 149 people whose contribution to the development of the science of geology is noted, but Mohr's preface makes it clear he does not claim to be comprehensive. In a slim volume of 65 pages he could not hope to be and this book will provoke more reading around the subject.

It is available from the author at Tonagharrun, Corrandulla, Co Galway for €10 including postage.

DOWN BELOW, SOMETHING STIRS...

Your Editor enjoyed this letter from overseas and hopes you do too. For Prime Minister, if you like, you can substitute Taoiseach and for his Deputy the Tánaiste (Mary Harney) but it is not suggested the latter has an earthly turn of phrase or that we wish harm to any of these important people.

“Tectonic plates are moving beneath the Prime Minister...” Now here’s a phrase that hit the headlines a while back, and showed John Prescott (his Deputy) to have an unexpected gift for geological metaphor. Indeed, it’s another example of a geological term infiltrating the common language. It’s wonderfully evocative, a few brief words that encapsulate the feeling of a landscape, hitherto sunlit, stable and benign... suddenly, treacherously, falling away from beneath an emperor’s feet; a landscape devastated, and no longer his dominion.

What do you associate with the movement of tectonic plates? A thousand documentaries about killer earths and savage planets provide an instant, almost subliminal answer. Cities in ruins, or entire coastlines swept into the sea; forests thrown to the ground, and fleeing populations. If only, if only the earth wasn’t cracked into a lethal, unpredictable crazy pavement, then we’d all be able to live prosperously forever, and sleep safely in our beds.

Plate tectonics, that perfectly-proportioned offspring of continental drift, has certainly made the transition from being the most far-reaching and successful hypothesis of the earth sciences, to entering public demonology as the begetter of earthquakes and tsunami, hyper-eruptions and landslides.

Let’s try, though, to apply a different spin to it. The most astonishing thing about plate tectonics, something which I still can’t fit into a perpetually astonished cranium, is just how astoundingly benign and non-catastrophic a process it is, all



things considered. For the catastrophes, if you just think on what actually happens to the planet’s crust, should, you imagine, be far worse. Give a dog a bad name... To remix our metaphors, it’s as if a homely old golden retriever was ambling down the road, only to be denounced as a Rottweiler on the loose. It’s bountiful Mother Earth, painted as Lady Macbeth.

Consider, for instance, that awesome, ever-opening, planetary-sized scar, the mid-Atlantic Ridge, where it rises above sea level to form Iceland. What do Icelandic people do? Do they flee the conflagrations, the all-consuming magma? No, they settle. They live, prosperously (if, as a visitor, you want to see how prosperously, just try buying a beer). They farm. They fish. Sure, now and again, farms or sections of roads

or occasionally even towns are buried under lava or ash. But people move away, annoyed at the loss of real estate, and then move back and start building again. Given that they’re living exactly where the Atlantic is cracking apart, they seem mostly to live a pretty quiet life.

It’s true that the collision zones of plate tectonics can provide some more serious violence. Right now, for instance, a thousand kilometre-long, 100 kilometre-thick section of Pacific Ocean floor is being forced down beneath South America. Things getting in the way suffer badly. Entire ocean islands are simply sliced into pieces, scrunched and mangled. This is the territory of big earthquakes, and of the more viciously explosive volcanoes.

Still, considering the sheer scale of the ongoing crustal rearrangement, the landscape, if not perfectly benign, is still generally habitable. When the devil does come out of the bottle, what kills people mostly stems from poverty. An earthquake that can kill tens of thousands in, say, Bam in Iran, will kill just hundreds in San Francisco or Tokyo, simply because of better building



design. And big fierce volcanoes are hard to overlook and, these days, easy to monitor. Really, you shouldn't live near them. Trouble is, in an overcrowded world, many people don't get the choice, and volcanic soils are fertile, so today's full belly outvotes tomorrow's disaster.

There's also a flip side to plate tectonics. They give us a nice dry home. The continents, the accumulated scrapings, as it were, of the whole messy process, float eternally, like so many Flying Dutchmen, high on the backs of the ever-moving plates. So what? – you might say. If there wasn't plate tectonics, then there would be no continents, but we humans would still have evolved, wouldn't we? We would just be web-footed merpeople, gliding elegantly through a deep calm global ocean, instead of being clumsy landlubber humans.

Fat chance. Without the land, there would be no rivers, and without the rivers, no large-scale cycling of nutrients into and through the oceans. With such a scenario, it would be hard to imagine gill-bearing humanoids appearing. Evolution might, perhaps, have got as far as some bad-tempered bacteria fighting over a few nutrient scraps.

There's another reason for thanking our lucky stars for those shifting plates. For our planet generates an awful lot of internal heat, because of the radioactivity inside it. That heat has to escape somehow, and conduction isn't fast enough, because the earth is simply too big. So the almost-but-not-quite solid interior of the earth is slowly convecting, like jam being simmered, and this motion drives the overlying plates, which in turn provides a wonderfully regular means of magma to reach the surface to release its heat

Let's imagine an earth without such a smoothly-running heat exchange device. In fact, we don't have to imagine. Venus is a rocky planet, and about Earth-sized. It doesn't have plate tectonics. It seems to have evolved a different, and much scarier, form of heat release. From the amount of the meteorite impact craters on it, its land surface seems to be about half a billion years old throughout. Strange.

Half a billion years ago something seems to have happened. That something has been called 'resurfacing', when Venus created for itself a brand new landscape.

The scenario involves half a billion years plus of pent-up heat suddenly coming to the surface in a planet-wide maelstrom of lava. The whole planet, in this interpretation, literally turned itself inside out. This would have been bad news for any recently-evolved Venusian life-form, no matter how many tentacles it possessed.

What makes the difference between these cosmic bodies, between planetary Jekyll and planetary Hyde? A good deal of the answer might be plain old water. The earth has lots of it. It's a great lubricant that can help even 100 kilometre-thick slices of crust slide past each other. The water on Venus boiled away a long time ago, and those thick swirling clouds aren't steam but hot vitriol. On a dry planet, plate tectonics, seemingly, can't work; there's just too much friction. And so steady heat-release seems to have been replaced by intermittent Armageddon.

One can make a good case that we really are living on the best of all possible worlds. The good Doctor Pangloss was right all along, spot on the button. It's amazing how it all works. The earth really is a dream machine.

That's not to say that we should just take it for granted. There is a tendency – even, dammit, among the research funding councils – to imagine the earth as having inner workings that are somehow both perfectly constant, and fundamentally detached from its living skin.

But even a dream machine has occasional hiccups. The tiny irregularities in the earth's heat regulation machine, the creaks and belches, the small interruptions of rhythm, may have more consequence than we generally imagine. When it comes to the great extinction events that have interrupted the onward march of Life, for instance, it's the meteorites that tend to grab the biggest headlines. But



at least a couple of the big extinctions coincided with enormous magmatic outpourings, if not (thankfully) on a Venusian scale.

These outpourings are rare events. More pertinently, though, it's recently become clear that smaller globs of magma, injected into carbon-rich muds, may have released huge amounts of methane and carbon dioxide into the atmosphere, to cause sudden temperature hikes of five degrees centigrade or more.

Sounds familiar? Such gas outbursts may be the nearest analogue for humanity's current carbon spree. The good news is that, in those ancient events, the climate stabilized geologically soon. The bad news for us is that 'geologically soon' meant hundreds of thousands of years.

Food for thought, indeed. We've got a lot to learn about how the internal plumbing of the planet works and how it interacts with its living passengers, and such questions are quickly becoming of more than just academic importance. Research councils please note.

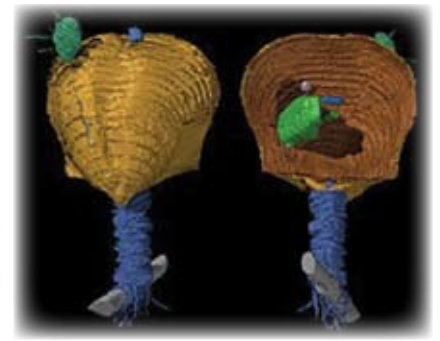
Meanwhile, let's pray that those plates beneath our feet keep moving. And perhaps John Prescott might have sought a more precise metaphor to describe the predicaments of his Prime Minister. Say, by describing him as placed, in an airtight metal canister, on the surface of planet Venus, waiting for the next resurfacing event. Some of his parliamentary colleagues – though one would naturally disapprove of any hint of uncharitable spirit – might quite enjoy that notion.

**Jan Zalasiewicz,
University of Leicester**

The Herefordshire Lagerstätte

A 3D GLIMPSE OF SILURIAN LIFE

Marie Cowan reports.



We are able to resurrect ancient creatures and project them into the 21st Century

**Dr Mark Sutton
Imperial College London**

I went, on the 8th September 2005, to the BA Festival of Science, Trinity College Dublin, where amongst so much amazing science I was most taken by the Herefordshire Lagerstätte project. This latter subject has found its way into Nature, Discovery News and the Sun no less! It involves collaboration between researchers from Yale, University of Leicester, University of Oxford and Imperial College London.

Dr Mark Sutton began by setting the scene....“In the early 1990s, Dr Bob King, then a mineralogist at Leicester University, was wandering over rocks of Silurian age in the Welsh Borderland, when he found something a little unusual. This was a smooth, round and yellowish stone; a ‘nodule’ or ‘concretion’ in geological parlance. On a whim he split it open with his hammer, to find a small dark shape inside, which he recognised as a fossil of some sort. The fossil did not look especially interesting, but nonetheless he took it back to Leicester, where eventually it made its way onto the desk of David Siveter, a palaeontologist in the same department. As soon as Dr Siveter put it under his microscope, a sense of excitement and urgency suddenly developed; he quickly realised that this was no ordinary fossil. In the following months Dr Siveter and colleagues returned to the site and started to collect and examine the nodules in bulk. Slowly but surely the true nature and significance of the fossils became apparent. **Bob King had stumbled onto one of the most remarkable fossil deposits yet to see the light of day, now known as the Herefordshire Lagerstätte.**”

Dr. Sutton explained that these conservation deposits (properly ‘Konservat-Lagerstätten’, or just ‘lagerstätten’ for short) allow palaeontologists to reconstruct whole animals and communities with much more confidence. Probably the best known lagerstätte is that from the Burgess Shale of British Columbia, which contains a range of often bizarre fossils from near the time of the ‘Cambrian Explosion’, the dawning of animal life around 540 million years ago.

The fossils of the Herefordshire Lagerstätte represent a community of small invertebrate animals that lived on the sea floor about 425 million years ago. They died and were preserved when they were suddenly engulfed in ash from a volcanic eruption. The animals themselves soon rotted away, but their shapes were faithfully recorded, initially by the ash itself, and then by crystals of calcite that filled the resulting hollows.

Dr. Sutton explained how his team “first select a fossil for processing, and then grind it away in layers of 20-30 microns at a time, taking a digital photograph of each freshly exposed surface. The fossil is entirely destroyed, but a record of its 3D form exists as a series of several hundred images”. The images are then aligned and edited to remove imperfections. Then, using a program that picks out the edges of the fossil on the 2D slices, “we wrap a surface over them and reconstruct them into three dimensions. The surface is then rendered using off-the-shelf graphics software to produce either a still image, or a rotating animation which can be examined from different angles – a virtual fossil”. Finally, the images are enhanced by adding colour to pick out different anatomical structures.

One of the fossils (see picture above) that this team of American and British scientists have identified and digitally reconstructed is the first example of a fossilized brachiopod complete with its pedicle, the stalk attaching it to the sea floor, and its lophophore or feeding organ.

Bethia serraticulma is described by Dr. Sutton as “an articulate brachiopod, a type of shellfish unrelated to the molluscs. Brachiopods of this type were very common in the Silurian, and are well known as fossils from their shells; many palaeontologists have spent their entire careers studying these remains. However, although many thousands of articulate brachiopod fossils have been examined over the years, not one had previously been found with its soft-parts preserved. *Bethia* preserves its stalk or ‘pedicle’ with which it attached itself to the sea floor, and also its lophophore, the many-tentacled feeding organ that all brachiopods possess. The pedicle in particular is unlike that of modern brachiopods and provides an example of the pitfalls inherent in assuming that the soft-parts of ancient animals were similar to those of modern relatives”. As a bonus, three other ‘baby’ brachiopods are attached to the *Bethia* specimen, also preserving their pedicles.

I also took the opportunity to view the array of posters in the BA Festival of Science Perspectives project and was delighted to see that the winner was a geologist! This year’s perspectives winner was Nicola McLoughlin, a PhD student from the Department of Earth Sciences at Oxford University. Her poster highlighted the central role geologists will play in ethical and theological questions that will follow if we find life on other planets. ‘Are we a superior life form to what’s out there? Was life on Earth seeded from elsewhere? How special is our planet? How unique are we? These are some of the questions finding life on Mars would raise,’ said Nicola.

ES2k would like to thank **Patrick Orr, TCD**, who facilitated the visit and press conference.

CUTTING EDGE COMPANY

The Belfast Geologists' Society last June investigated the stone cutting industry at Kilkeel, at the foot of the Mournes. The visit was by kind invitation of **McConnell's Stone Yard, Kilkeel** and the party was led by Norman McKibben and Harvey & Wesley McConnell.

The work undertaken varies from small local commissions to large international projects. It was here the stone for the ***Diana, Princess of Wales Memorial Fountain*** was cut. Not, maybe unfortunately, Mourne Granite but granite from Cornwall transported to Kilkeel where it was cut to the requirements of the architect and transported back to London's Kensington Gardens.

Glynn, the software designer, showed us the computer programmes that enable very precise, detailed designs to be produced to each client's specification. These programmes guide the enormous cutting machines. Even so, depending on the rock type and design required, some pieces can take up to 100 hours to cut. They can wear out dozens of expensive diamond-headed tools, imported from Italy, in the process to achieve the high quality finish.

As well as new products, the company can also reproduce existing intricate stonework that needs to be replaced due to weathering. Here, sophisticated laser scanners record the detail of the existing item and using old photographs or drawings add ornamentation that has been lost.

This is no longer a local stonemason using local stone. Even so, the skill and expertise gained locally over many

years is now being used to select rock from quarries around the world to best match the required end product. A wide range of rock types, from sandstone, limestone, slate, basalt, granite and marble is handled. Local quarries provide granite from Castlewellsan and Newry, and limestone from Armagh. Other rocks come from elsewhere in Ireland, Great Britain, Europe and South Africa. Occasionally closed local quarries are reopened (with special planning permission) to allow rock to be cut that exactly matches that used in an historic building.



May Twist and Marion Allen 'like geologist's in a toy shop'

One local commission was to provide new stonework for the famous 'leaning tower of Belfast', the Albert Clock, demonstrating the expert work of the stonemasons, such as Declan who works for this company. The intricate detail completed by hand, taking such fine

judgement, concentration and so many hours is remarkable to see. Such skills will be cherished by future generations. If you saw a recent RTE programme showing the restoration of the Portland Stone figures on the top of a Dublin building you can only be amazed by the stonemasons craft. *Was the building the Bank of Ireland on College Green?*

The visit provided amazement and reminded everyone that geology is about our lives today. Our houses, churches, roads, memorials – and much more - are mostly built of stone or products from the ground. Yet the very people who use the buildings and roads or have grave stones cut for their loved ones can be the objectors to quarrying! We left the stone yard much wiser for our experience.

Shirley Gray,
Ballymena.

(We hope to have an article about the use of local stone, rather than import from China etc., in another issue. Editor)

ES2k TO HOST TEACHERS

ES2k will host the ***Earth Science Teachers Association*** for its annual conference in **September 2007**. ESTA is working to improve the quality of earth science teaching, whether it is as part of a geography, geology or other science course. The venue, probably in Belfast, has yet to be chosen and we will be seeking sponsorship to try to make this a landmark event. The conference will probably last two days and be preceded and/or followed by field trips.

This is a preliminary notice and if anyone wants to help in any way please let us know. Whatever you do, if you are a teacher, make a note now to watch out for details.

Editor



FANTASTIC FOSSILS

Rockwatch Joins In



What an incredibly successful day we had at **Marble Arch, County Fermanagh** on the May Bank Holiday last year. The sun was shining and the crowds poured in, many travelling long distances to join us. Everyone had lots of fun. Whole families worked together to create wonderful Carboniferous

dioramas and learn much about the local Carboniferous fossils at the same time. Making fossil replicas was also a very popular activity and as well as a range of Carboniferous fossils, there were many from both the Jurassic and Cretaceous periods – just to ring the changes! We are very grateful for the help on this activity from staff and pupils of **Methodist College** in Belfast; they were certainly kept busy all day long.

There were also fossil identification games for everyone to try their hand at and wax fossil rubbings to do and take home. Visitors challenged the experts to identify the rocks and fossils they brought along. Then they were shown how to identify minerals and learnt about some of their uses. There was a hunt to find and identify some of the many fossils in the building stones of the Visitor Centre and its surrounding walls – an activity new to everyone that I spoke to. Maybe this will start a trend and encourage a greater awareness of building stones and their geological origin!

I'm delighted to also note that the café, the bookshop and the boat rides through the awesome underground cave system, all had a most fantastically busy day with the hundreds of visitors to the **Family Fun Day**.

Our thanks to all the staff at Marble Arch and especially to **Kirstin Lemon**, without whose support and encouragement the event would not have been possible.

I do hope that **Rockwatch** will be able to make a return visit to Marble Arch next year, with perhaps a residential field trip for Rockwatch members to coincide with a Family Fun Day.

Susan Brown,
Chairman.

For further information about Rockwatch, check the web site: www.rockwatch.org.uk

or e-mail: rockwatchatga@btinternet.com or write to: Rockwatch at the GA, Burlington House, Piccadilly, LONDON W1j 0DU.



GIANT'S CAUSEWAY ON TRACK AGAIN

It is pleasing to know that at least the minimum acceptable number of local geologists is involved with the new management of the World heritage site. Namely, the Geological Survey of Northern Ireland and Paul Lyle of the Ulster University, Jordanstown. These are the people to speak to if you have an idea you would like considered.

The management plan looks much more reasonable than had seemed likely at one stage. The only disappointment is that the opening of the lower path, which leads across some of the most critical sites for fully understanding the volcanic rocks, is put in stage two and is clearly still a long way off. Generally, however, our representations seem to have been heard although it was surprising that the English consultants in Sussex didn't bother to acknowledge some of the letters sent by our members after the Environment & Heritage Service requested them.

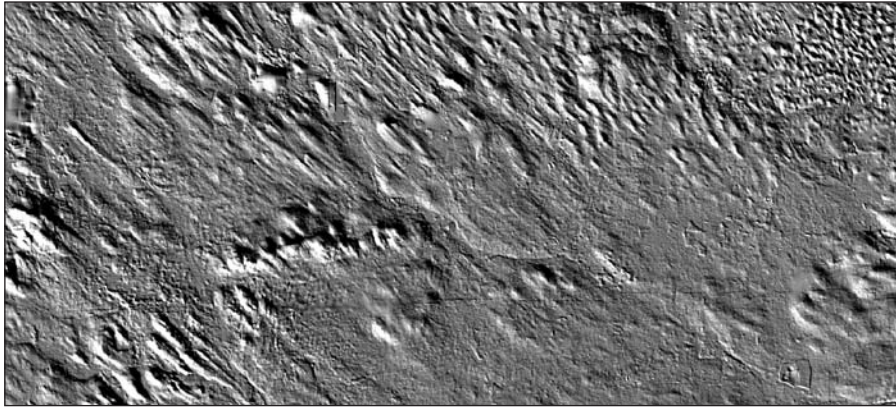
The architects have been chosen for the interpretive centre and the design looks appropriate for the site. Choosing designers for the interior displays is apparently well advanced. We will try to speak to the architects for a future issue. The Causeway Coast is one of the brightest jewels in the crown of Irish geology and the way it is developed needs to be watched. If our readers would like to air their views in this magazine please write or email me and they will be published.

Editor



Slieve na Calliagh, County Meath

Slieve na Calliagh (*Mountain of the Sorceress*) ridge rises to 278m at its highest point, Carnbane East. It houses the Loughcrew tombs, one of the largest Neolithic cemeteries in the country,



Azimuth shaded digital elevation model of the area around Slieve na Calliagh. The ridge itself is in the centre left of the image. The drumlins to the north can be seen, as can the Blackwater channel to the immediate east of the ridge, and the crag and tails further southwest. Image is 45km x 20km.

and the Megalithic Tombs on the ridge crest have decorated stones in the same pattern as Newgrange. The tombs have an astronomical function which is much more complicated than the Brú na Bóinne complex, and is based around the equinoxes rather than the solstices. The nearby Loughcrew Demesne is the birthplace of Saint Oliver Plunkett and the family church is still standing.

On Sunday 4th September around eighty heritage enthusiasts (Meath Archaeological and Historical Society) gathered at the Loughcrew Tomb car park to walk the ridge. However, this was a trip with a difference, as the primary focus was not on the archaeology or history of the area ... but the geology. The group walked up the eastern edge of Carnbane West, the ridges' second highest peak, where bedrock crops out and has been smoothed by the passage of ice across it during the last glaciation; having been plucked on the southern side it exhibits classic *roche moutonnée* forms. The Lower Palaeozoic greywacke sandstone bedrock itself was studied, as well as the glacial forms on it, and the impressive views of the surrounding glacial landscape were appreciated.

The most striking feature on the top of Carnbane West is a large sandstone erratic boulder that has been carried

from the northwest to the top of the ridge by ice during the last glaciation. Boulders of the same sandstone are present strewn across the entire ridge crest. In fact, many of the stones

comprising the Loughcrew Tombs themselves are of this sandstone and have obviously been picked up from their resting place across the ridge during the construction of the tombs.

The Slieve na Calliagh ridge itself is also composed of erosion resistant Lower Palaeozoic greywacke, shale, sandstone and siltstone rocks. The view from the top of the ridge is quite spectacular,

and well worth the walk. To the north the drumlin region is clearly visible, with Lough Sheelin in the distance. Southwards the linear moraines of the Diamor area can be seen to the east of the high, wooded ridges of Loughcrew Demesne. Looking west, in the near distance, the Murrrens Esker and associated gravel complex is visible, as well as the high peaks at Fore and those further west in County Westmeath. The view itself gives an amazing insight into the regional geology of the area, as it forms the southwestern boundary between Longford-Down Silurian metasediments and the Lowland Carboniferous limestones, as well as giving a perfect view of the Ice Age landscape of east central Ireland.

The final stop was at the tombs themselves. The rock sources for the tombs were discussed, as well as the early landscape into which humans settled in this region in Mesolithic and Neolithic times. This one ridge therefore gives an insight into rocks and their formation many millions of years ago, the ice age about 20,000 years ago and the early history of Man. The integration of natural, archaeological and historical heritage has the potential to enhance tourism in Ireland.

Robert Meehan



Robbie Meehan discussing geological aspects of the Loughcrew tombs.

MEDICAL GEOLOGY

At first glance, Geology may seem far removed from human and animal health. However, rocks and minerals and the soils derived from them contain all of the naturally occurring major and trace elements that are critical to our well-being. Most of these chemical elements are taken into the human body via food, water and air. Unless the concentrations of these chemical elements remain within specified ranges, then humans and animals experience detrimental effects that in the most severe cases *can be fatal*.

The emerging discipline of Medical Geology is the science dealing with the relationship between natural geological factors and health in humans and animals.

Paracelsus (1493 – 1541) enunciated a fundamental of toxicology when he wrote

All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy.

Thus, intake of too much of any given chemical element, as too little can have equally deleterious biological effects. There are many documented examples. The correlation of iodine deficient rocks and soils with areas of endemic *goitre* is well known, particularly in Ireland. *Selenium* deficiency leads to endemic heart disease (Keshan disease) and to endemic bone ossification

(Kashin-Beck disease) in China; selenium toxicity is seen in cattle in parts of Ireland, as is *molybdenosis*. *Arsenic* toxicity in groundwaters has received serious attention in Argentina, China, Hungary and Bangladesh and elevated *radon* concentrations in waters and air are widely reported from many countries and can be correlated with local types of rock. Other metals that have given rise to toxic responses in humans and animals include mercury, cadmium, chromium, lead, thallium, beryllium.

Medical Geology is also concerned with topics such as airborne mineral dusts and human health, and much more.... In 2000, UNESCO established the International Geological Correlation Programme (IGCP) project 454 on Medical Geology and Earth and Health has been selected as one of the primary themes of the International Year of Planet Earth 2005-2007.

There was a Medical Geology meeting at the Geological Survey of Ireland last October. It was the first Irish attempt at raising public awareness in the subject and to discuss some of the issues in an Irish context. See www.gsi.ie for more details but ES2k will be returning to this subject during the year.

Pat O'Connor,
Geological Survey of Ireland



RIA CORNER

BEST POSTER AWARD

The RIA Geosciences Committee sponsored a prize for the best student poster at this year's postgraduate students meeting of the British Geophysical Association, which was held in NUI Galway on

1st and 2nd September. The winner was **Edward Horncastle (Leeds University)** for his poster entitled "*Core flow modelling: constraints from dynamo theory*".

ELECTORAL REGISTER

If you know any geoscientists who

should be on the electoral register for the RIA Geosciences Committee but who are not, please encourage them to sign up. Apart from eligibility to vote in the next Committee election, everyone on the electoral register receives bulletins from the committee. Anyone wishing to sign up has only to email Vanessa Berman: v.berman@ria.ie

FOR INFORMATION

Committee membership: Dr Chris Bean (Chair), Prof. Pat Shannon (Vice-Chair),

Dr Julian Menuge (Secretary), Mr David Ball, Dr Catherine Coxon; Dr Catherine Dalton (Representative of the Academy Committee for Geography); Dr Eve Daly; Mr Garth Earls; Ms Vanessa Berman (Programme Manager); Prof. John Gamble; Dr Deirdre Lewis; Dr Peadar McArdle; Mr Eoin Moran; Dr Aodhagán Ó Rodaighe (Representative of Irish Committee on Climate Change); Dr Matthew Parkes; Dr Ian Sanders.

Julian Menuge, Secretary, Royal Irish Academy Committee for Geosciences

CONGRATULATIONS TO ES2k SECRETARY KIRSTIN LEMON

Double celebrations for our Secretary as she is awarded her Doctorate of Philosophy by Durham University for her work on limestones of the English Lake District and becomes engaged to be married to Graham Thompson. Kirstin is a Queen's, Belfast graduate and currently works for the Geological Survey, Belfast but is based at the Fermanagh Marble Arch Caves where she is helping develop educational aspects of the Geopark. Graham is, we learn, also a geologist but has put that to one side to work in the Ambulance service. We wish them every happiness in the future.

WHO WAS 'BLUE JOHN'?

Rather what is Blue John? It is a beautiful and unusual blue coloured rock found near Castleton in Derbyshire, England. The Romans mined it two millennia ago. People have prized it and considered reasons for its colour up to the present.

Distinctive jewellery is locally manufactured from this rare mineral. The young lady, with an eye for the unusual, might accept such pieces as a gift from her *beau* to add a unique touch of style to her smart appearance. Such items do not go out of fashion, as confirmed by the brooch and ear-rings shown here which were purchased for my *belle* 30 years ago and still are often worn on special occasions.

I have used French words because, in former times, this mineral was cut and polished in France. Here the mineral was referred to by its colours 'blue and yellow' (*bleu et jaune*) which was conveniently, if inaccurately, translated as 'Blue John'. Perhaps, if the stone had been worked in Italy or Ireland, it would now be known as '*Azzurro Giovanni*' or '*Gorm Sean*'. An alternative explanation for the name was to distinguish the blue mineral from the local lead ore, referred to as '**Black Jack**'.

Why is it blue? What causes the characteristic wavy striations? The mineral is quite pure fluorite, calcium fluoride, which normally is a white powder or a colourless crystal. The most probable explanation for the colour is that, during deposition of the mineral onto the underground rocks from hot solutions, cooling as they welled up from far below, some radioactive material was present. The radiation damaged the fluorite, separating the fluorine and leaving behind very tiny particles of calcium metal (each around one thousandth of a millimetre in diameter). Dispersions of very large numbers of these scatter light, giving the blue appearance. This means that, like gold and a few other elements, the normally very reactive calcium metal can exist in nature but only because

each tiny particle is exceptionally well protected from air and water by fitting snugly into the mineral crystals around it. The wavy blue striations record the intermittent and irregular crystal growth in the cavity or joint when the dissolved calcium fluoride was being precipitated from the cooling solution.



Fluorite, having a blue tinge or colour, is found in many other places around the world. I believe that it has been noted in The Burren, Co.

Clare but I could not find it there myself. *I wonder if any of our readers can throw some (blue) light on this?*

Andrew Galwey, Belfast

DO YOU KNOW ME?



This picture is a watercolour painting of a large boulder. Do you recognise the boulder and know where it is located? Petra Coffey is offering the **PRIZE** of a section of her own home produced honey to the first person with the answer. The picture is possibly by the 19th century GSI Geologist and Antiquarian, George Victor Du Noyer. If the location can be identified it may be possible to confirm whether Du Noyer ever went there.

ANSWERS TO THE EDITOR PLEASE.



Photo: Courtesy GSI

Dr. Ralph Horne retired from the Geological Survey of Ireland recently. He had been with the Survey since 1969 and for the last 24 years was Assistant Director.

Born in Aberdeen, Scotland he has the unusual distinction of giving his name to the 'Horne Nunataks' on Palmer Land in the Antarctic where he worked with the British Antarctic Survey. He is also particularly well known for his work in the southwest of Ireland and for his 'Guide to the Geology of Dingle'.

His knowledge of the technical aspects of mining and exploration was exemplary and as Assistant Director he helped guide the Survey through a major period of development with great distinction.

Always a friendly figure at Beggars Bush I hope that Ralph will not entirely retire from the geological scene but might give us the benefit of his wisdom and wit in the occasional article for ES2k. We certainly wish him well in his post-Survey career.

See GSI Newsletter at www.gsi.ie for more details.

Editor



Part of Arun's fossil and mineral collection



Dr. Arun Kumar Sarkar

Little did we know when the Belfast Geologists' Society visited Rathlin this summer that it would be the last time **Arun Sarkar** would be with us. He was one of a number of medical consultants who, on retirement, turn their minds to geology. It has been speculated that this is because of the similar 'diagnosis' approach to the two sciences but maybe it is just a change to work with something, in our case rocks, that feel no pain and don't complain.

Sarkar was a charming gentleman born in Bangladesh. He married an Irish girl and after 30 years as a distinguished consultant at the Braid Valley Hospital, Ballymena retired in 1999. He then started collecting fossils and mineral specimens. Glaciers, the Giant's Causeway and the origin of life fascinated him. His enthusiasm for the subject was infectious and in a short time he became an expert amateur. It was just before the Rathlin trip that he visited China and picked up the viral infection that proved fatal last October. BGS members had hoped to have the pleasure of his company for much longer and offer sincere condolences to his wife Norma and two daughters, Cosi and Nova.

Editor

WOODLAND CAFÉ FOR COLIN GLEN

Bet you didn't know that Colin Glen, Belfast is the 8th most visited attraction in Northern Ireland and the 5th most visited Forest Park in NI. The Colin Glen Trust deserves everyone's plaudits for the way it has managed this gem of a glen. At the Woodland Café opening on 30th August the Trust Chairman, Barry Gilligan, emphasised the work of its staff before thanking the sponsors, including EHS and Readymix Concrete, most warmly. Gradually the centre has had to reduce its reliance on government funding. So partnerships have become extremely important and he thanked especially the Lisburn Partnership (**Supporting peace and building reconciliation** is the slogan) and its Chairman Roy Hanna.

Paul Rankin, the celebrity chef, who talked of the revitalised Belfast of which he is so proud, performed the opening ceremony. You can now enjoy a walk in this delightful glen, see the red squirrels, try to understand the rocks *and* have welcome refreshment in the interpretive centre. It is well worth a visit.



Editor

Paul Rankin and Jonathon Craig, Mayor of Lisburn. Eating healthily at the Woodland café.

GEOGRAPHY TEACHERS CONFERENCE



Chris King talking to teachers in Antrim

Every year the Geography teachers of Northern Ireland meet for their conference. In 2005, like the past few years, it was held in Antrim. Always brilliantly organised it is an opportunity for new advances in teaching materials and methods to be evaluated. The conference generally has a keynote speaker on a topic of current interest followed by parallel sessions of workshops and talks to interest both primary and secondary school teachers. A large number of organisations also take stands displaying posters and materials.

As in the past two or three years ES2k had a stand and received an encouraging level of interest. It is excellent to meet old friends as well as see the enthusiasm of the young teachers who have just entered the profession. This year, however, ES2k went a step further.

One of our leading members, Karen Parks

of Methodist College, held a workshop on ways to capture pupils' imagination by practical classes using everyday materials. Additionally, ES2k had invited Chris King, head of the Earth Science Education Unit in Keele, Staffordshire, to give a workshop on its behalf.

Chris tackled the subject of plate tectonics, again using everyday materials in a practical demonstration of how a difficult subject can be brought alive for students. His group has spread the concept of 'teaching the teachers of earth science' across England, Wales and Scotland. This certainly means helping geographers and geologists but just as important are the chemistry, physics and biology teachers because earth science is a cross-curriculum subject.

Teaching aids are being rapidly developed in Britain - pamphlets, books,



Workshop in action

videos, rock sets etc. The trouble is that few of them use examples from Northern Ireland. Whilst an international perspective is important, local children, especially in the early years, obviously relate better to examples from their own region. So we need more locally produced teaching materials.

When the Earth Science Teachers Association meets in Northern Ireland in September 2007 it is hoped that earth science in the curriculum in Ireland will receive a boost.

Editor

Well well well, new group formed!

For those interested in groundwater and related matters, ES2K has been notified of a new fledgling forum, the **Groundwater Group of Northern Ireland**. It is intended that the group will provide a focus for discussion and promotion of groundwater and hydrogeological matters, pertinent to Northern Ireland.

Groundwater is a valuable resource in Northern Ireland providing a small yet significant proportion of water for public supply as well as supporting thousands of domestic, agricultural and industrial private boreholes, wells and springs. Some major brands of bottled water are also sourced from Northern Irish aquifers.

Additionally groundwater contributes a proportion of flow to many rivers, lakes and wetlands helping maintain water levels and associated ecology during drier periods.

Any interested individual or group is welcome to come to our meetings or lectures. For further details please contact either Peter McConvey at GSNI Tel: 028 9038 8454 email: peter.mcconvey@detini.gov.uk or Dr Ulrich Offerdinger Tel: 028 9097 4517 email: U.Oferdinger@qub.ac.uk

IRELAND OCEAN DRILLING



A huge ocean drilling ship, *JOIDES Resolution*, was in Dublin Port last April. Preparing to go to sea to 'drill for Ireland'. At the front of world ocean research the 143 metre long ship contains 12 scientific laboratories and can drill in water as deep as 8,200 metres. It has a dynamic positioning system that enables it to hold position for drilling in spite of wind and waves.

Irish scientists joined the international team on board when it left to drill an extraordinary mound on the seabed deep off the west coast. In detail, to drill the Challenger mound in the Belgica



Peadar McArdle, Director, Geological Survey of Ireland and Minister Noel Dempsey, T.D.

province on the edge of the Porcupine Seabight!

The fact that, through the Geological Survey of Ireland, Ireland has become affiliated to the "Integrated Ocean Drilling Programme" shows its growing reputation for sophisticated geoscience capability.

Announcing the affiliation was the



On-board microscope scans rock sample



Minister for Communications, Marine and Natural Resources, **Noel Dempsey T.D.**

The ship, the scientific equipment aboard, the spotless laboratories, and the enthusiasm of the scientists were most impressive.

You might ask '*What was the result of the drilling?*' I was told that results, like any scientific research, would take a while to appear. The drill data has to be fully analysed before information can be released. Also that it is eventually their intention to have a web site from which teachers can abstract course 'blocks'. We (ES2k) will try to bring you more about this drilling in a future issue. In



Racking for drill core

particular I should like to have an account of life on board such an unusual ship. What an exciting initiative by the Irish government. It has the potential to bring unexpected discoveries in that region so near but so remote, the deep ocean floor.

Tony Bazley

NEW TEMPORARY EXPOSURE INITIATIVE

Geologists, from amateur to professional, have a chance to contribute to valuable data recording in a new scheme organised by the **Geological Survey of Ireland** and run using its website (www.gsi.ie). For many years,



but especially in the recent decade or so of intensive development throughout the country, geologists have realised that there is a serious problem in recording details of rocks and



sediments in exposures that appear during construction projects and are covered or disappear equally fast. Infrastructure work on roads, tunnels, ports and other major developments creates such temporary exposures but they may equally be found in the foundations of a new house down the road.

These cuttings and holes may be into superficial deposits like sand and clay (Quaternary) or they may be into bedrock. Both provide opportunities to gather data on the geology of the country that would otherwise require targeted drilling or trial pits. Such data contributes to ongoing compilation of more accurate maps in either the 1:100,000 geology map series, the new 1:50,000 series or in Quaternary maps. Some data from developments in urban areas is more useful in the Geotechnical database, contributing to more accurate

prediction of ground conditions and depth to bedrock.

However, for lack of geologists with scope to record such temporary exposures, and a lack of any statutory responsibility on developers (such as there is for archaeological recording), the national records have been sadly diminished by wasted opportunities. Now the GSI has initiated an initial web-based scheme, which utilises a '**TE-Spotting Form**'. It is aimed at any willing volunteer with a geological or non-geological background and can be found on the GSI website at www.gsi.ie. Its format is similar to that of GSI's 'Landslide Ireland' reporting form. It is designed for simplicity so that any interested and observant member of the public can transmit information back to GSI about temporary exposures they come across in their own area, or whilst travelling around. The form assumes no geological knowledge and you are guided through a series of options for describing the rocks or sediments. Digital photos are also requested, not only because they are 'worth a thousand words', but in providing a lasting record of what may prove an ephemeral feature, they will form an integral part of the new database.

A further complementary scheme for detailed recording of temporary exposures by a regionally based network of experienced volunteer geologists is also being piloted, but a future article will report on that initiative in more detail.

Matthew Parkes



SCHOOLS DEBATE

Motion: *This House believes that extraction of aggregates and metals can be achieved in a sustainable and environmentally friendly way.*

Debating were two teams, each made up of four students, from Foyle & Londonderry College and Methodist College, Belfast. The event was held in Belfast and sponsored by the Quarry Products Association (NI).

Both teams had thoroughly researched the subject and were a credit to their respective schools. Darren Khera, Clare McClintock, Michael Brown and Damien Kelly represented **Foyle & Londonderry College** with Ashleigh Weir, Robert Coburn, Katherine Keir and Alistair Brown for **Methodist College, Belfast**. Prizes were presented by Gordon Best (QPANI) with Clare McClintock the winner of the best speaker award.

The above event took place last March but is worth mentioning because debating in front of an audience is not something schools, or indeed universities, appear to give much weight to these days. The students involved have now experienced the nerves that afflict everyone the first time they have to 'stand alone and make a case'. They will be that much better prepared for the adult world of work in the years ahead. The NI Quarry Products Association's sponsorship of the project is to be applauded

NEW QUARRY YEAR BOOK

The inaugural Year Book for the Quarry Products Industry in Northern Ireland was launched in May last summer. It is an attractive glossy journal that now will vie with its equivalent in the Republic of Ireland. Both give interesting data about the industry. The Northern Ireland journal talks of sustainable development as 'moving on from being simply desirable to become accepted as an imperative'. It reviews mineral planning issues and discusses training for people entering or in the industry. Watch out for the 2006 edition due to be published later this year.

We reported in the last issue on the Quarry Products Association (NI) support of the Northern Ireland Raptor Study Group – chaired incidentally by Jim Wells MLA (*pictured*). Quarries, especially after their working life, become important refuges for wildlife. They can also be useful outdoor laboratories for schools. Safety for visitors is always an issue, of course, but with appropriate care quarries have much to offer. It is noted that there is a **schoolzone** on the site www.qpa.org; worth visiting but note that it is the British branch of the organization and the site is said to be under development and due for full update in the coming June.

We hope that maybe some Irish examples of quarries or quarry owners involved with helping education will at some time appear on a local website. The QPANI appointed Laverne Bell as 'Diversity Officer' last year. She is the person to contact if you have any questions on the geodiversity or biodiversity work of the QPANI.

Editor



Gordon Best (Regional Director QPANI), Tommy Gallagher MLA, Jim Wells MLA, Seamus McKeague (Chairman QPANI)



Laverne Bell

JUST OUT



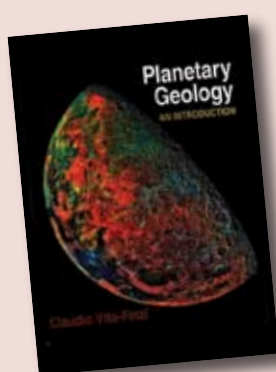
be taken to see the various, in places spectacular, features. There is even a section titled 'Excursions by Dart'. In the 'Classic Geology in Europe' series (6) and produced by Terra Publishing, the UK price is £13.95 (probably €20-25).



The Geological History of the British Isles by Arlene Hunter & Glynda Easterbrook

This book, first published by the Open University in July 2004, has the best of pedigrees coming from Arlene Hunter who, as many readers will know because she was once ES2k Treasurer, is based in Belfast. Designed for undergraduates in their early years it is likely to also appeal to amateur geologists. Now from the Geological Society Publishing House it can be ordered online from www.geolsoc.org.uk/bookshop. Price £18.50 plus P & P.

Tony Bazley



Another new book, this one I will review for you in the next issue, is 'Planetary Geology'. Again published by *Terra* it shows in a relatively simple way that planetary geology should form an integral part of Earth science. Advances in knowledge of our neighbours in space have been truly astounding in the last couple of decades. The book looks as though it can bring you up-to-date. UK price £19.95 (€30-35).

Coming too late for a full review – but we will have one in our next issue – is an unusual book. Unusual in that it covers the whole of one of Ireland's Provinces, so is especially welcome.

Two acknowledged experts lead the reader not just to the rocks but the archaeology, history and wildlife of a varied and fascinating region. If you have time to visit **Leinster** this is the book for you.

Although it claims to be written for the non-expert there is no doubt that a little Earth science knowledge will help. Its strength is the detailing of trips that can

Irish Geologists' Association go north

Not to the arctic wastes as pictured on the front cover but the rather warmer – it was actually very hot – northeast coast of Ireland. This corner of Ireland has rocks rarely found elsewhere on our island. They are the relatively young rocks that were 'protected' when the volcanic lavas flooded over the northeast almost 60 million years ago. Cretaceous limestones (chalk),

Jurassic and upper Triassic mudstones. Most are rich in the fossils of past marine life. The coastal scenery is spectacular. It was 11th - 12th June and I had the pleasure of leading the IGA group, which included its President Barry Long. Three pictures reflect the enjoyment of the weekend.

Tony Bazley



Glenarm



The cave of Cave Hill



Cushendall

St Patrick Was Here

We know he was. The site of his first church in Ireland is not far away and nearby Downpatrick Cathedral boasts his gravestone. So, are these indentations on a stone the marks of his 'Bishops' rod made when he was walking along the Quoile River, Downpatrick in south County Down?



Photo: Bill Beattie

The fascination with large rocks or unusual marks in rocks seems part of the human psyche. Often, when a large boulder is unearthed in diggings it is left standing for people to wonder at; a form of natural art! At one time they might have been objects of worship, taken to the extreme at Stonehenge in Wiltshire, England I suppose. We will have an article about this 'love' of large stones in a future issue.

What about St. Patrick's rod marks? It seems disappointing to describe them as entirely natural and quite common features in the rocks of County Down. But they are! The rock itself is hard grey sandstone, here covered with green algae. The sandstone started off as soft sand deposited in an ancient ocean many millions of years ago and as sediments built up so the water was squeezed out and, in time, the soft sand became cemented together to form rock. The water contained dissolved minerals, especially commonly calcium carbonate, that increased as the fluid was squeezed out. In places the carbonate crystallised out, maybe choosing a particular sand grain or bit of shell as the nucleus. From this nucleus the carbonate developed into a round ball shape. Although the shape would ideally have been circular, variations in the sand or clay in the rock and the direction of pressure within the rock produces nodules of varying geometry. In fact in places these nodules have been used to show what pressures the rock has undergone during its history.

So the 'rod marks' are nodules or, another name for the same thing, concretions. Actually they show where concretions once lay. In this case the carbonate of the concretion has been differentially dissolved away by rainwater, causing it to disintegrate and leave a cavity. In the middle of the elongated cavity you might be able to see the core of the concretion and outwards from this there are circular marks showing how the carbonate mineral grew within the sand. In this case the concretions formed along an ancient bedding plane in the rock, so are in a line – can you just make out the edge of a third concretion filled with moss at the top of the picture?

It all happened rather a long time before our saint came on to the scene but is, maybe, nearly as amazing. My thanks to Bill Beattie of Killinchy Probus Club for asking the question.

Tony Bazley

“SEABED ISSUES SURFACE”

So read the headline of a short article in the *English Nature Magazine* (Issue 77) early in 2005. It went on to say that English Nature has launched a £2m project to improve the understanding of the impact of offshore aggregate extraction on the seabed and raise people's awareness of its nature conservation importance. Currently, nearly 25% of the sand and gravel used in England and Wales comes from the seabed. Dredging this removes the surface layer of the seabed, killing and dispersing species such as starfish, sea urchin and seaweed.

Space was obviously short in the magazine because it didn't go on to mention other important effects. The Bristol Channel is one of the sources of aggregate and removing material from sandbanks, some quite near shore, has a knock-on effect. The seabed in this situation is not static and sand is eroded from elsewhere to fill the gap, so holiday beaches lose sand. Is this the reason the sand level along parts of the South Wales coast has dropped by a metre or so? Also, with greater depth, the waves are less restricted and greater erosion occurs along the coast, perhaps increasing cliff falls and even landslides.

It could be said that this study is too late. Certainly, however, not too late for those of us in Ireland. We can learn from it. Offshore aggregate abstraction will increase here in the future. Are the appropriate controls in place to ensure any damage to the seabed and coast is as small as possible? You might ask who has the responsibility for approving abstraction and how they are advised. If you know any of the answers or have an opinion please write to ES2k!

Editor

BEHIND THE SCIENCE

– Silke Hartmann



An interview by Marie Cowan

Tell the readers a little about yourself....

I am from a city called Leipzig, in East Germany, and south of Berlin. It has a population of 500,000.

Why did you choose to specialise in underground water (hydrogeology)?

I wanted to work in applied science in an environmental field. As a young teenager I was very much aware of environmental issues from German government initiatives.

How did you qualify?

It was at the University of Leipzig that I studied Geophysics graduating with a Master's degree in 2000. The most interesting project was fieldwork in Namibia, which involved using ground geophysics to locate a certain type of rock beneath a salt-water aquifer. I stayed in the Etosha National Park and also worked at the Geological Survey of Namibia for the German Advisory Project.

Then I came to Leeds University, UK, where, funded with money from the EU, I studied for a PhD degree. My watery research topic was "*Flow and transport in the confined Chalk of East Yorkshire*".

When did you join the Geological Survey of Northern Ireland?

I joined GSNI in August 2005 to work as a hydrogeologist on implementing new European legislation, namely the Water Framework Directive (WFD). The Environment and Heritage Service (EHS) of the Department of the Environment (NI) fund my post and I usually spend one to two days a week at their offices in Belfast city centre.

How does your work address the European Water Framework Directive (WFD)?

Water from underground sources, such as springs, wells and boreholes, makes a significant contribution to the water

supply of the north of Ireland. I am responsible for building a network of sites to properly monitor the quality of this water. It is one of the requirements of the Directive. Currently the water from about 90 boreholes is checked every three months. Collection of water samples from a borehole involves a strict protocol, followed by transfer of the samples to a laboratory for analysis. A contractor for EHS does the analyses and sends the data to us at the Geological Survey for interpretation.

What do you think are the greatest challenges in relation to underground water management?

The greatest challenge is sustaining the quantity and quality of the water.

Water abstraction has to be managed in a sustainable manner. Basically, water taken from underground should not exceed the rate at which it flows back into the rock, so water levels are maintained. We mustn't allow so much pumping of water that it starts to significantly lower the flow of rivers or to dry out bog land. Many rare animals and plants depend on the maintenance of such environments or ecosystems.

We must also gain a better understanding of the relationship between water underground and on the surface because of the increasing problems of pollution. If there is a pollution danger or incident we need to quickly be able to say how and where the pollutants will move in the water.

Some industries, including farming, already use water from private wells and boreholes. As charges are increased for public water supply more users will probably consider drilling their own private wells. This is likely in places to lead to an increased use of underground water. Where this happens, for example, for drinking water, it will be important to educate potential well-owners regarding proper design, construction and maintenance to protect the quality of water abstracted.

Using datasets at the Survey we will be able to improve our knowledge of where groundwater is more or less vulnerable to impacts from industry and building or overpumping. This will assist both developers and EHS in ensuring protection of this valuable resource.

Can you describe your working relationships with other people?

We attend the meetings of the Groundwater Working Group of Ireland as we have similar problems (e.g. agricultural land use). There is also a UK Technical Advisory Group of government and academic scientists who meet using a workshop approach to knowledge transfer. Recently formed is the Groundwater Group of Northern Ireland, which hosts meeting and lectures. I also

contribute to reports written to enquiries received by the Survey and EHS from other government departments, consultants, industry and the general public. On a day-to-day basis, I work with geologists, other hydrogeologists, laboratory technicians, environmental consultants and other government scientists.

How would you describe the attitude of the German government to the environment?

Since the early 1990's the German government has introduced many policies, initiatives and public information campaigns to raise awareness of environmental issues, e.g. recycling, charge for plastic bags at supermarkets, water metering, taxation on sealed surfaces such as concrete or tarmac driveways – so encouraging the use of permeable alternatives. It is also trying to reduce the use of private cars and encourage the use of public transport. When large concerts or sports events take place in German cities, the organisers and transport regulators cooperate to ensure that the entrance ticket already includes the bus or train ticket (for a reduced price) 2 hours before and after the event. Also there are initiatives that one travel pass holding adult can take another adult on public transport on evenings or weekends for free.

How do you think cultural attitudes to the environment can be changed?

This is not an easy process and takes at least 10 years; however it involves a combination of education beginning at Primary School level, public awareness campaigns, increased recycling resources to facilitate rural and urban tax payers, and *finer for offenders*.

Where do you think environment should be on the agenda in relation to health, education and the economy?

I think it should be in the top three but am unsure which other should make way for it.

What would be your careers advice to students of earth and environmental science?

University students should endeavour to get practical experience in industry and choose an applied PhD or industry-focussed Masters. For youngsters about to go into higher education choose your degree with care. Lots of people think a university education is essential and as a result many countries are pushing to increase the uptake of university places. My observation is that this can result in students reading degrees that they never use or eventually going to work in an entirely unrelated job. If there were, instead, a fully functional apprentice scheme available that would teach essential trades and technical skills it might be worth considering.

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