IN THIS ISSUE:
Tynagh minerals;
Book reviews;
Natural art;
Earthquake shakes;
Galway buildings;
Swiss geology;
Greenland’s klondyke;
Early diamond drill;
Elements of earth.
And more ....
First, an apology. The article entitled ‘A Tale of Two Magmas’ in the last issue (16, pages 29-31) was badly edited at its final stage. On the first page some of the script slipped under the photographs and made reading it...impossible. It was such a beautifully illustrated article and written so well that it has haunted your editor ever since it was pointed out. In fact only one person mentioned it but I am sure many others noticed. The one person wanted to use the article on a field excursion for students. That need has been satisfied but the article will be re-published in the next issue – with no mistake. I hope the authors will forgive me.

Then mention of a cloud on the horizon. Government budget cuts are threatening all small organisations like ESI. It looks as though the generous sponsorship over many years from the Northern Ireland Environment Agency will shortly cease. Your committee will be looking for ways of replacing it – where there is a will there is a way. If anyone has any ideas please write in.

This issue has the usual mix of articles. Brian Black, the well-known broadcaster, has posed interesting questions about the Arctic, and our variable climate comes up in several places. One article questions the rate of climate change and whether humans are a significant influence. Controversial – yes, but this is the sort of difficult question that needs to be debated. Politicians hate them but scientists should always be seeking the truth.

There are several new books to consider. None are overly expensive and all will teach you something. It would have been good to have such books available when I was a student!

Lastly the beautiful article on minerals at Tynagh will bring out the collecting instinct in most of us but, like fossils, it takes a good eye and real perseverance to find and then identify them. As an editor it is a real privilege to be sent such articles and I thank all the authors most sincerely. They all take considerable time and trouble – it is appreciated.

Acknowledgements


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Tony Bazley, Editor, Earth Science Ireland, 19 Inishanier, Killinchy, Newtownards, Co Down BT23 6SU Email: rbazley@btinternet.com

In Communion

The good grey rock that loves the grasping hand
The mountaineering poet wrote*. With rare perception.
How deep was he
To feel a love within the stone for those who hold it
In need, and more especially, in wonder.
With hammers and learning geologists tell its story,
With hands and wonder others feel its spirit.
Hands that grasp the good grey rock with love.
All beings children of the rocks,
We are of the earth, the rocks are the earth
A man, a stone, in communion.

David Kirk

*Showell Styles (1908 - 2005), from his poem ‘Epilogue’
TOP TABLE CHANGE

Marie Cowan, our Chairperson for some years, stepped aside at the Earth Science Ireland AGM on 21st January this year. She has driven the group forward during her term of office, especially in the fields of outreach and education. We owe her a huge debt of gratitude and wish her every success as Director of the Geological Survey of Northern Ireland, a post she took up last summer.

KIRSTIN LEMON takes the reins

We are in safe hands with our new Chairperson, another Doctor of Philosophy, Kirstin Lemon who is well known to many of us ‘in the business’ but for others a short introduction seems appropriate and we asked Kirstin herself to write it:

‘Earth Science Ireland, or ES2K as it was then, was founded in 2000, the year that I graduated from Queen’s University, Belfast. I was in the penultimate class to graduate in geology and as a result there was no other option but to go somewhere else if I wanted to carry on with my studies. I chose to go to Durham to research a PhD in the Carboniferous strata of Northumberland. Many people scoffed that I had chosen such a ‘boring’ fieldwork area; after all it wasn’t looking at volcanoes in Montserrat, or scuba diving off Borneo to look at modern coral reef analogies! But I loved every minute of it, rain and all, and unlike my colleagues, I could just jump in the car and drive to my fieldwork area.

My Carboniferous research ended up being a springboard for my entire career, one that I wouldn’t necessarily have chosen but one that I quickly fell in love with and am now vehemently passionate about. Promoting geology to the public was a major part of the job description for Geopark Geologist at the Marble Arch Caves Global Geopark, and seeing that it was an area dominated by Carboniferous geology, I applied and was successful. I spent nearly 10 years working in Co. Fermanagh and Co. Cavan, dealing with the public, community groups, schools, and universities, helping them to understand, appreciate and cherish their rocks and landscapes. Over the years I have worked with thousands of school pupils and hundreds of teachers and I hope that I have inspired at least some of them to go on and study geology in later life.

My career has moved on slightly and I am now working with the Geological Survey of Northern Ireland, as the Team Leader for Environment and Hazards. I am pleased to say that I still work with the public and regularly deliver geological-themed events all over Northern Ireland. However, my main passion is inspiring young people and since returning to GSNI I have been very fortunate to still be able to work in this field. Through ESI we have already managed to develop a suite of primary school resources in Earth Science and have also continued to train teachers in how to deliver Earth Science lessons in the classroom.

As the newly elected Chairperson, I am adamant that this work will continue and progress further, especially given the lack of any form of geology in the primary school curriculum, and the declining uptake in geology and related subjects at post-primary level. As some may see this as a severe omission, I see it as an opportunity for organisations such as ESI to step up to the mark and champion Earth Science education. It is up to us to encourage and inspire the next generation of Earth Scientists and together as an organisation there is no doubt that we can achieve this.’

School ‘flying the flag’

I was delighted to see this information board when I visited the Isle of Iona, just off the Isle of Mull on the West Coast of Scotland last autumn. It was in a field close to the harbour on the road leading up to Iona Abbey. I understand that it was the brainchild of the local primary school, which is to be congratulated. Good to see somebody was flying the flag to promote the fascination of rocks which is geology. It could not really be missed by visitors on route to the Abbey.

Ian Forsythe

Geological Map of the Mull and Iona Area

Issue 17
TYNAGH
– jewel in the crown of Irish mineralogy.
By Stephen Moreton

There exist a small number of localities around the world that have produced an extraordinary diversity of mineral species. Not just a dozen or so, but scores, even hundreds. Such mineralogical treasure troves include such famous names as Lavrion in Greece (366 minerals), Langban in Sweden (ca. 270 minerals), Tsumeb in Namibia (241 minerals) and Franklin, New Jersey (361 minerals).

It may come as a surprise to readers to know that Ireland too has such a mineral hot spot. At about 125 minerals, it is not in the premier league, like those just listed, and falls far short of the current leader (Jáchymov, Bohemia, 384 minerals). But, as probably only a few score localities globally can boast more than 100 different minerals, it is internationally significant, and is easily the most mineralogically diverse site in Ireland.

As many of these remarkable places are large polymetallic orebodies with extensive oxidised zones, it is no surprise that Ireland’s own “super locality” is the giant base metal deposit at Tynagh, Co. Galway. And therein is the reason for its extraordinary mineralogical diversity, as we shall see. But first the history of its discovery is worth relating.

There had long been hints that something extraordinary lay below the surface a little north of the village of Tynagh, near Kilimor, S.E. Co. Galway. The Geological Survey Memoir, published in 1865, records a silver mine in nearby Carhoon, a mine so old that nobody could remember who worked it, or when. It also reported galena (lead) found “while opening a cut along the road”. And the locals complained, “that when the ground thereabouts is tilled in the spring all their fowl die, being poisoned by something they pick up.” A look at the 6” geological map shows copper-stained sandstone, and galena, are widespread in the area.

With so many encouraging signs it is surprising it was another century before the discovery was made of one of the most valuable ore deposits in Ireland. In the 1950s a group of Irish ex-pats with experience of mining and exploration in Canada turned their sights homeward and began investigating areas with histories of mining (see ESI Issue 16, page 13). One of these was Tynagh, and soil geochemistry soon turned up anomalous values for lead and zinc. Drilling commenced in November 1961, the very first hole passing through 12 metres of overburden and then 41 metres of black mud before encountering solid limestone with minor galena. That black mud, upon further analysis, turned out to contain 6 % combined lead and zinc. Two more holes in this black mud found lead levels up to 20 % and, before long, a boat-shaped depression was outlined some 600 m long, and 50 wide, filled with metal-loaded mud and boulders resting on a deposit of similar dimensions, though lower grade, in the solid limestone beneath – about 12 million tonnes of high-grade ore.

Geologically, the deposit was developed in Lower Carboniferous sediments where a fault brings these against Old Red Sandstone rocks. The fault provided a conduit for metal-bearing fluids, which penetrated the Carboniferous sediments, impregnating and replacing them with metallic sulphides and barite. In places the fluids breached the seafloor and gave rise to sulphide chimneys colonised by tubeworms. Further away iron and silica-rich fluids deposited a sedimentary iron-ker formation surrounding the main deposit of sulphides and sulphosalts of iron, lead, zinc, copper, nickel and silver (27 in all, but dominated by just four – pyrite, galena, sphalerite and tennantite), together with at least 11 gangue minerals, mostly barite, calcite and dolomite.

Whilst a respectable tally it was what happened when uplift and erosion exposed the deposit, sometime in the Cenozoic, that put Tynagh on the mineralogical map. The pyrite oxidised on exposure to the atmosphere, generating acidic solutions that began to dissolve the limestone. Over time, the limestone was eaten away, creating an enlarging depression in which the more resistant constituents, such as galena...
and clays, formed a residual mud. Slumping of material from the sides mingled in boulders and even pieces of timber. Near the surface oxygen was abundant. Deeper down conditions were reducing. At the margins the limestone kept the pH up, where it was absent acidic conditions could prevail. Some regions were permeable and leaching was intense, in others percolation was hindered. And the distribution of such local variations changed as the depression grew and its contents were physically redistributed.

With such a variety of changing chemical environments, differing widely in pH, concentrations and variety of anions, and a good selection of metals to start with, the stage was set for a geochemical frenzy. As the other sulphides began to oxidise solutions carrying lead, zinc, copper and silver were produced and migrated through the decomposing mass. Where these encountered limestone they precipitated carbonates, such as cerussite, smithsonite and malachite. In regions of particularly high carbon dioxide concentration, azurite was formed. Where the limestone was impure, silica and alumina were available, giving rise to minerals such as hemimorphite and dundasite. Where reducing conditions were encountered secondary sulphides precipitated, or native copper and silver. And the tennantite added arsenate to the mix, leading to many more combinations with the available metal cations.

The result was several million tonnes of black mud containing rafts and masses, up to hundreds of thousands of tonnes, of oxidised ore, and an extensive redistribution of metals, with concentrations along the margins where they precipitated against the limestone. There was even a silver-rich gossan.

This “oxide” ore was enriched relative to the primary material beneath making it very valuable. Being unconsolidated, it was simply dug out by mechanical excavators and processed. As Ireland was not, at the time, a noted source of fine mineral specimens, mineralogists and collectors were slow to hear of it, and much had been consigned to the crushers by the time they did.

To keep them out of the way of operations, a pile of high-grade ore was dumped by the car park, for interested visitors to pick through. But few turned up, and the heap was in the way, so it was sent to the crushers. Then, too late, collectors finally got wind of what was happening and began to appear.

A fickle attitude on the part of the management did not help save the national mineralogical heritage either. At times access was allowed, at times not. An English mineral dealer, Richard Barstow, did access the opencast as things were winding down and rescued fine specimens of the commoner minerals, notably malachite, azurite and cerussite. Some of the finest ever found in Ireland. He also recovered superb examples of the rare hydroxyl carbonate of lead and aluminium, dundasite. A few others also got in and anecdotes circulated for years after of masses of azurite two feet across, refrigerator-sized boulders of jackstraw cerussite, and crystallised native copper ramifying through the black mud.

As a poor teenager at the time, without transport, I could only watch in despair from afar. When I did finally get there in 1981, a polite request to look over the tips was met with a loud, curt and rude, “No!” at the entrance office. Finally, in 1983 with the last, unhelpful, incumbents departing, and the site coming under the control of the amiable Mike McCarthy, of Priority Drilling (see obituary in issue 16), access was possible. But, by then, the opencast was flooded, so activities were restricted to the extensive waste heaps. For a while these provided a bonanza to collectors. Whilst not reaching the legendary dimensions of the treasures of the opencast, many good hand specimens of the principal supergene ores turned up, plus smaller ones of all manner of rarities.

Now amateur collectors were finally able to prove their worth. Until they had unfettered access, the published literature by professional geologists was the only source of information on the mineralogy. Around 70 minerals had been identified and listed, but often without adequate description or supportive data. Armed with binocular microscopes, and having contacts with access to laboratory facilities, their discoveries poured forth. By the century’s end amateurs had added about another 50 minerals to the total.

Foremost amongst them was Swiss schoolboy, Antoine de Haller, who first
Earthquakes in Ireland!
What’s Shaking Us?

by James Barry, Kinsale Community School

It was just before 8 o’clock in the morning, December 4th, 2013 and I was sitting in the kitchen eating breakfast when I heard a loud bang and the pendulum lights swung. The cutlery rattled on the table and I thought something had hit the roof of the house. I was experiencing my first earthquake.

The earthquake measuring 2.6 on the Richter Scale occurred at 51.45° N, 8.72° E off the coast of Co Cork in the North Celtic Sea.

The hypocentre of the earthquake was approx. 18km south of Ballymacshoneen on the Seven Heads in West Cork. I was curious to find out what caused the earthquake and also wondered about earthquakes in other parts of Ireland. My friends and neighbours also speculated about what caused the earthquake. Many people whom I talked to wondered would the drilling for oil off Barryroe have caused the earthquake.

So I and my two friends Luke and Tadhg decided to do a project for the BT Young Scientist and Technology Exhibition. We entered our project in the Intermediate (Group) Chemical, Physical and Mathematical Sciences section. We were delighted to win the Geological Survey of Ireland Special Award. The picture below shows us - James Barry, Tadhg McCarthy & Luke Henderson with Mary Carter of the GSI who organises the stands.

Our objectives were

- To examine earthquakes in Ireland and specifically the earthquake which took place on December 4th, 2013 in the North Celtic Sea off Barryroe in West Cork.
- To study the geology of the North Celtic Sea area and find out possible causes of the Barryroe earthquake.

We decided to take three different experimental approaches. First, we looked at seismic traces of the North Celtic Sea. We used the BIRPS Atlas Map, (BIRPS = British Institutions Reflection Profile Syndicates) and examined SWAT 5. (SWAT is the South West Approaches Traverse). From this we identified faultlines in the NCSB (North Celtic Sea Basin) as well as the location of the epicentre of the earthquake and the location of the recent drilling for oil.

Next, we carried out interviews. We spoke with geologists Dr Bettie Higgs of UCC and Prof John Walsh of UCD as well as Tom Blake and James Grannell of DIAS. We visited the Geological Survey of Ireland and Cork City Library to research seismicity in Ireland. We also visited Providence Resources in Dublin. Providence Resources is the company which is operating the Barryroe Oil Field.

Finally, we conducted a survey in the Timoleague and Barryroe area to find what people believed caused the earthquake and what they experienced during the earthquake.

Results of Examination and Interpretation of Seismic Traces:

We needed to establish first that the event off Barryroe was in fact an earthquake so we compared seismic traces of different events - a major earthquake, a nuclear explosion, a local quarry explosion and the trace of this local earthquake.

Like all good things, the bonanza did not last. In 2004 construction began of a gas-fired power station, and a galvanising plant. The area around the old crusher, which had been particularly prolific, was cleared and concreted over, and other areas grassed over. Whilst some waste remains untouched by these developments it is well picked, and the site is now but a faint shadow of its former glory.

For a young spark to be able to work in such a fine museum is a real bonus. His name is David Grannell and he is a young earth scientist! He explained to me that Tynagh helped guide him down that path.

Tynagh have made it into collections all over the world, thanks to their efforts. Barstow, and numerous amateurs, did their best to remedy that when the opportunity arose, and specimens from Tynagh have made it into collections all over the world, thanks to their efforts. Barstow, and numerous amateurs, did their best to remedy that when the opportunity arose, and specimens from Tynagh have made it into collections all over the world, thanks to their efforts. Barstow, and numerous amateurs, did their best to remedy that when the opportunity arose, and specimens from Tynagh have made it into collections all over the world, thanks to their efforts. Barstow, and numerous amateurs, did their best to remedy that when the opportunity arose, and specimens from Tynagh have made it into collections all over the world, thanks to their efforts. 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There were no S waves to be seen on the local quarry explosion trace. The S waves were very weak on the nuclear explosion trace. Both P waves and S waves were clear on the trace we looked at of an 8.2 magnitude earthquake in Chile. The Barryroe event trace also had clear P waves and S waves so identifying it as an earthquake. On the B.I.R.P.S. seismic trace of the North Celtic Sea we identified the North Celtic Sea Basin and the fault lines in the basin area. Using information provided to us by Providence Resources we were able to identify the location of the Barryroe Test Well in relation to the hypocentre of the earthquake and they were 41km apart.

Results of Survey:

Demographic Information

From the population we surveyed, we have the following results:

- A gender split of 49% females and 51% males.
- The age category which filled in the greatest number of surveys was 36-50 year olds.
- 52.3% of the people whom we surveyed had secondary level education, 7.3% of people had primary education and 40.4% of people had 3rd level education.
- 86.8% of the people we surveyed felt the earthquake.

Awareness and Knowledge of the Earthquake

- Only 11.9% of the people we surveyed realised the event was an earthquake.
- 52.3% of our population felt shaking and heard a loud noise. Another 35.7% either felt shaking or heard a loud noise while only 11.9% experienced nothing at all.
- 50.3% of our population believe that drilling for oil in the North Celtic Sea was the cause of the earthquake. Only 19.9% blamed plate movement/faulting while 27.2% didn’t know.
- There was very little difference by gender as to what people believed caused the earthquake.
- Those with a primary education either identified oil drilling only as the cause or else didn’t know while all the others listed a variety of causes but again oil drilling was the most common cause named.
- 35.1% of our respondents had heard of an earthquake affecting this area before and of these the 20-35 age group were most informed about this.

We arrived at the following conclusions

- Ireland is seismically active.
- There are a number of causes of earthquakes in Ireland:
  - In Donegal earthquakes are associated with faults dating back to the Caledonian Fold Mountain Building Period and the current cluster of earthquakes in the area is likely to be associated with the Icelandic plume due to volcanic activity there.
  - The earthquakes in the Irish Sea are most likely associated with glacial rebound since the last great Ice Age.
- The seismic event off Barryroe was an earthquake.
- Half of our surveyed population believed this earthquake was caused by drilling for oil.
- The drilling occurred two years before the earthquake so is highly unlikely to have been the cause. This is supported by the views of geological experts in UCC, UCD, DIAS and by Providence Resources too.
- The North Celtic Sea area was affected by The Armorican (Hercynian) Fold Mountain Building Period and this also left a legacy of faults. We identified these faults in the seismic traces. The youngest fold mountain building period, The Alpine Folding, is ongoing. The African Continent is moving relentlessly northwards, colliding with Southern Europe and as a result is creating the Alps in Europe and the Atlas Mountains in North Africa. Spain and Portugal are being pushed Northwards in an anticlockwise movement and this is affecting southern Ireland. The sea bed off the south coast of Ireland is not flat, the rocks of the sea floor have been deformed into ridges by Alpine Compression.

So we have concluded that the most likely cause of the December 4th 2013 earthquake off Barryroe is Plate Tectonics causing movement along an old fault line (an ancient lineament) in the North Celtic Sea.

(Trace courtesy of Providence Resources)

(Trace courtesy of Providence Resources)
GREENLAND’S KLONDYKE

by BRIAN BLACK

First circumnavigation of Warming Island

The crump and roar of calving glaciers struck a deep sense of dread into us as we moved slowly through the pack-ice, heading towards a narrow channel between the mainland ice-sheet and a tide-washed snow field on what was now an island. A few years ago this was an ice-bridge linking Kap Gladstone to the rock and ice mass of East Greenland. But the Arctic is warming faster than any other region on earth. Climate and the subsequent melt has created what is now called Warming Island, discovered by an American geologist who had studied satellite images of the East Greenland coast. For me, on my fourth season spent charting the new waters off Liverpool Land, it had become an obsession. Gradually as the sun dipped and lost its heat, the calving eased and I brought the boat into the channel. My primary objective was to seek out new passages along the coastline and to establish anchorages that would provide shelter, not just for us but for other small boat sailors who might come to these shores as the ice retreat opens up new cruising grounds.

Bergs and growlers encumbered the channel but there was little tide running as we approached. By late afternoon the sun had lost its heat which slowed the calving activity, making the ice relatively stable. We pressed on with great caution, testing the depth and on the look-out for rocks along what we would call the Warming Island Passage. We anchored that night on the deep side of an old moraine, hoping to land on the island next morning but shortly after breakfast the fog returned and everything disappeared in a wet freezing blanket creating almost zero visibility. As a result, the only evidence for the first ever circumnavigation of Warming Island is the satellite trace that was recorded on the yacht’s chart plotter.

Mountain-forming and global warming

Looking back on that voyage and the others I have had before and since, I have other memories of East Greenland - great towering mountains rising straight out of the sea, cliffs, glaciers everywhere, a brutally beautiful landscape where only the whalers had been before and none of them up close to the shoreline because back then it had been blocked off by a solid wall of fast ice. Global warming has changed all that and a land that was once inaccessible is now being revealed and even to someone like myself with a very limited knowledge of geology, the story of Earth’s evolution is there to see.

The area that holds my particular interest, Liverpool Land, is essentially the result of the massive movements and violent upheavals of the Earth’s crust associated with the Caledonian mountain-forming period going back almost six hundred million years.

Scramble for resources... and fears

Elsewhere on that massive continent, in the wake of the rapidly retreating icecap, geologists are testing for valuable mineral deposits. Ores and hydro-carbons are being sought and already sufficient deposits have been recorded to make Greenland the focus of an international scramble for natural resources. Last year, more than one hundred and twenty licences were awarded to explore for oil, gas, iron ore, emeralds and nickel. In 2013
there were claims that the world’s largest single deposit of thorium along with massive deposits of uranium representing an estimated eight per cent of global production were at Kvanefjeldet near the west coast town of Narsaq. This needs to be seen in the context of major potential environmental damage but the stakes are enormous – for instance, assuming legal and political approval, then the uranium deposits in Greenland have the potential of making the EU nuclear industry self-sufficient for the foreseeable future. Major concern surrounds possible radio-active dust clouds, cancer worries for workers and toxic substances being washed out onto the surrounding land and into the ocean affecting the marine environment as well. These worries focus the political debate in the Greenlandic parliament in Nuuk with fears for agriculture, fishing and human health risks throughout southern Greenland.

It is also thought that Greenland holds the largest deposits of rare earth minerals outside China; rare earths are vital for digital technologies. Recently an Australian mining company claimed the rare earth deposits at Kringlerne as probably the biggest in the world. It’s not surprising that huge industrial giants are poised in the wings and Chinese conglomerates in particular are preparing to invest heavily, right across the Arctic.

**Evaluation without exploitation… so far**

At present, the focus is on prospecting and evaluation with comparatively little exploitation of Greenland’s vast mineral wealth actually happening. One explanation is that while significant deposits have already been identified, there is uncertainty about what else may emerge as the ice retreats which could eclipse existing possibilities. Another major factor is that Greenland has no industrial infrastructure such as deep water ports and adequate power supplies which large scale mining projects would require. A report published by the international research group Brookings Institute entitled ‘Greenland’s Gold Rush’ examines a number of challenging issues confronting Greenland society today. For instance Greenland is facing a deteriorating economy, exacerbated by an aging population as the young and able migrate to Denmark...
making a bad situation worse. And while the mining and energy sectors appear to hold the best hope for economic progress, this will depend on outside investment. At one stage it looked as though China would be the driving force in this but as its domestic economy is slowing, investment in Greenlandic mining projects appears to be tailing off.

There has been much speculation about hydro-carbons with oil supposedly in great abundance in offshore waters, indeed some analysts reckon that up to twenty per cent of the world’s untapped oil and gas reserves lie in the region. While deposits in the Arctic basin may indeed be significant, the harsh conditions made worse by drifting ice-bergs make it unlikely that extraction will happen in the foreseeable future.

Too wonderful to spoil

After nine Arctic seasons since the late 1990s, my specific interest has been in exploring new lands and charting previously inaccessible anchorages where the ice-bound shoreline had, until global warming kicked in, prevented human access.

The thoughts of macro-economics and geo-political interests sit uncomfortably with the awesome beauty and staggering emptiness of a land that has held me spellbound over the years. In the greater scheme of things, carefully controlled outside investment and exploitation of Greenland’s mineral wealth could bring significant benefits to a country desperately in need of an economic uplift. Perhaps the ebb and flow of international finance will provide sufficient breathing space for proper policies to develop that will strike the balance between investment and the protection of this great wilderness. I hope so.

Brian Black is an independent television producer who specialises in environmental programme making. Most years he takes time-out to go exploring in the Arctic aboard his yacht Séafra. In this account he recalls a world first, the circumnavigation of an island created by global warming and his subsequent thoughts on the potential mineral wealth now becoming exposed due to ice-melt on the world’s largest island – Greenland.

**Book Review**

**CROSSES & TOWERS OF COUNTY DOWN**

The High Crosses & Round Towers of County Down, a field guide by Peeter Harbinson, Down Museum 2014 (£5)

Heritage Tourism is a relatively new term to promote different regions of the UK and Ireland and further afield to a wider tourist and leisure industry market.

This recent publication by Down Museum certainly aims to exploit important landscape features to both the local population and tourist market.

For many years we have had numerous archaeological and architectural publications which are very informative but are sadly lacking in one major respect – information about the stone itself. We have brief references to building stone being of ‘local limestone’ or a ‘Scottish sandstone’ or ‘Mourne Granite’ but little more about the geology of the rocks; where they came from and why they were used. After all, building stones are a delight to study. So it is refreshing to see in this publication an input from a local geologist, Ian Meighan, to highlight the geological background to these Round Towers and High Crosses in Co Down.

Each introduction to a High Cross or Round Tower has details of the geology in tabular form. The High crosses are all basically of granite of either Mourne or Newry origin. By studying the minerals and texture of the rocks it has been possible to precisely identify their likely sources, for example Downpatrick High Cross (Mourne Granite) is said to be from Thomas Mountain Quarry above Newcastle. Round Towers seem to be more likely to be constructed of a mixture of rocks, varying from local Lower Palaeozoic greywacke sandstone to more colourful Permo-Triassic sandstone and other igneous rocks. You will have to read the book to appreciate the variety but it certainly enhances the experience when you visit these fine monuments of time past.

Peter Harbinson and Ian Meighan are to be commended on a very useful guide which I hope will be a benchmark for future local publications.

*Ian Forsythe*
The quarries at Scrabo Hill, Co. Down are well-known to many Irish geologists. They are the source of Triassic (New Red) Sandstone used as a dimension stone particularly in Belfast but also in Waterford Cathedral, which contains a sandstone doorway that once opened into the Old Library in Trinity College. Trace fossils are developed in the Triassic Sherwood Sandstones, and include burrows and footprints of *Chirotherium*, a vertebrate of reptilian origin. A rare example of the latter was found in 1938 by Hallam Ashley a visitor from Liverpool, and is now in the Ulster Museum. The quarries have been the focus of fieldwork on the Ards Peninsula and visited Scrabo Hill to view the intrusions for herself. She published a petrographic account of the Triassic sandstone in 1928. Subsequently, in 1931, she published on the Ards Peninsula dyke swarms in which she delineated a suite of crushed examples confined to the southern portion of the peninsula (Figure 2).

In 1947 and 1954 she collaborated on a number of papers on the Dalradian of Co. Donegal with Arthur Holmes whose contributions to Irish geology are less well-known than those relating to geochronology. These examined metasomatism and Caledonian overprinting on older fabrics. Doris and Arthur had met on a field excursion to Ardnamurchan in 1931. Following the death of his wife, Doris and Arthur married in 1939; at the time he held the Chair of Geology at Durham and she was a lecturer, having been appointed by him to this position in 1933. Three years after their union they moved to Edinburgh.

Reynolds made significant contributions to Irish geology, principally in igneous petrology, and on the geological history and structure of Slieve Gullion, Co. Armagh. She published on monzonites from Newry, hornfels from Goraghwood and on albite-schists from Antrim whose alteration she attributed to Caledonian tectonic activity. She is now largely remembered for advancing the theory of ‘granitisation’ by which granite is formed from crustal rocks through chemical alteration by upward migrating fluids; this idea is now discredited. Although she was often controversial in her research, her impressive record was acknowledged through the award in 1960 of the Lyell Medal by the Geological Society of London.

GEOLOGY GOING STRONG IN THE WEST

Galway Geological Association

Alessandra Costanzo (GGA Scientific officer) & Damhnait Úi Mhaoldúin (GGA PRO officer) bring us up-to-date

Now in its fourth year, the Galway Geological Association, or Cumann Geolaíochta na Gaillimhe in Irish, is going strong and has more than 60 paid up members. It all started in September 2011 when a group of eager non-geologists came together to found the first amateur geology group based in the west. Many of the founder members had completed the evening Diploma in Scientific Studies in either geology or gemmology at the National University of Ireland Galway (NUIG). This tradition continues with new members joining the group from these very interesting courses together with many other new members with no previous training in geology.

Our first few years were tough, but great at the same time, and we are now happy to report on a vibrant organisation. Situated as we are between the granite and metamorphic landscape of Connemara and the limestone terrains of the Burren and east County Galway, we consider ourselves very lucky. We have incredible scenery and many readily accessible geological features on our doorstep.

From the start, the GGA has tried where possible to work with other organisations to promote an interest in geology. Each year we hold a number of joint events with GEOS (the NUIG student geology society) and many of our GGA members are also members of the Irish Geological Association (IGA) and Irish Quaternary Association (IQUA). Our inaugural meeting in 2011 was addressed by IGA President, Peadar McArdle, and our organisation was initially planned as a branch of the IGA. However, administrative difficulties precluded this arrangement and the group metamorphosed into the GGA. We are very happy to cooperate with any other organisations interested in geology and look forward to holding joint events in the future.

A recent survey showed that our members are interested in attending guided field outings as well as public talks but also want to participate in Saturday workshops and short evening courses. Recently a number of one-off workshops and some four and eight weeks courses have been organised covering such diverse themes as structural geology, gemmology, map reading and even cheese and geology! All classes have been well attended and some have even been oversubscribed. These courses are essential to the organisation as a follow-up to the diploma courses for some and also as a way of attracting and retaining new members. But the GGA is also about sharing a passion for geology and the environment in a light hearted way and we have also enjoyed organising...
fun events such as GGA pub quizzes, film nights and a photo competition.

The GGA has the help and encouragement of both Earth and Ocean Sciences and Geography in NUIG who allow us to use their facilities for lectures and meetings and support the group in any activities. Many GGA members were involved in the preparations for the re-launch of the James Mitchell Geology Museum in December 2013. This interesting but little known museum is situated in the Quadrangle of NUIG and presents an impressive collection of rocks, minerals and fossils from all over the world. Members were also involved in preparing a museum exhibition to honour Professor Martin Feely’s career on the occasion of his retirement. GGA members presented Martin with a gift to thank him for his very valuable assistance and commitment to the Association.

The GGA has also played an important role during Heritage Week in the last few years. The event provides the Association with a great opportunity to tell local people what it is all about and to attract new members. Events in 2014 included a geological walk in Salthill, a tour of the James Mitchell Geology Museum and a geological tour of Galway City centre.

There is more information about GGA on our website www.galwaygeology.net, kept always up-to-date by our dedicated webmaster, Cris Randolf. Our management committee under the able leadership of our Chairperson, Seamus McGinley meets once a month to ensure a full programme of events. Currently the committee is drawing up a list of events for 2015/2016. If you have any helpful suggestions don’t hesitate to email GGA secretary, Louis Carroll at galwaygeology@gmail.com.
Book Review

**BANNER ROCKS**

Banner Rocks – The Geological Heritage of County Clare by Matthew Parkes; published by Clare County Council 2015. ISBN 978-0-9541870-5-7; softcover; 64 p; €9.99 from local bookshops or Clare County Council (email: cmcguire@clarecoco.ie).

If you want a book title to mystify you then this is one. ‘Banner Rocks’. Unless, of course, you come from the ‘Banner County’ and know that it is a nickname for County Clare. The book doesn’t explain why it is so-called but a search of Wikipedia reveals that it relates to prolific banners and banner-carrying a hundred or more years ago.

The book itself does deserve a banner headline. It states that it is not a guidebook because whilst it provides a record of important rock features many are not accessible being on private land. It is, however, a magnificent record of the rocks of a particularly beautiful county and if anyone with a natural history interest is visiting then purchasing it will definitely enhance the experience.

‘Giants there be’. No wonder the ancients worried about the supernatural when confronted by a scene like that pictured on the cover. Surely it had to be huge hands that laid the pavement? Yet it is completely natural. Among other remarkable features are the many, but nationally rare, Mushroom Rocks that in some cases are difficult to explain – unless maybe you have seen a goblin sitting on one. Then there are the superb cave features including the Great Stalactite in Doolin Showcave. It was once reputed to be the largest free-hanging stalactite in the world but even without that title will make you gasp if you can find time to visit.

The Shannon Estuary, Bridges of Ross, Cliffs of Moher and Loop Head are some of the coastal features described and pictured. And mentioning pictures... could anything be much more spectacular than that of the cliffs near Loop Head shown on the inside front cover. Inside the back cover, but rather obscured by an ‘about the Author’ inset (sorry Matthew), is the only close-up picture of Liscannor Stone. It is a paving stone exported all over Ireland, and farther afield, to be used not least as the floor of bars and hotel foyers. Many people will recognise it immediately as ‘the slabs with meandering marks that look like the tracks of big worms’ – and they are indeed traces left by mud-grazing animals. The book has a short account of the Liscannor Stone industry, as it does about the historic mining (lead, silver and iron) and modern mineral exploration in the county.

Most of all, the features of limestone karst are described and with the Burren as its centrepiece this has to be as good an example as anywhere in the world. On a bad day, with the Atlantic Ocean beating on the county’s west-facing shore, the Burren with its sparse (but special) flora can seem eerie or even frightening but when the sun shines it is ethereal. Generally this book is beautifully illustrated with over half the pages taken up by pictures and illustrations. The text is short, to the point and not too technical. It doesn’t show pictures of the wide limestone landscapes but it isn’t a guide book. You can easily buy a guidebook with those pictures; this book gives rather more and is the simplified expression of a major and detailed scientific archive held by the county that will be used to aid future conservation.

The other book in the County Heritage series covered County Sligo. That was good but this one on County Clare is better. The lesson has been learned to put the geological history detail at the end so the casual reader is led straight into the countryside and its rocks. Maybe next time even the section upfront and entitled ‘What is geology’
can be similarly moved. This is a minor niggle because it only takes up 3 pages but the urge to explain plate tectonics at the start of anything to do with rocks maybe sometimes should be resisted. Something should also be said about the problem of access to sites and here the comment applies nationally. It seems odd that Ireland, with the friendliest of peoples should be less willing than the people of Britain to allow access to ground for walking and visiting natural features. Obviously there have to be some restrictions but surely local landowners can get together to open up more sites and routes – it should be a future aim of local councillors and would undoubtedly help the economy.

Well illustrated and laid out, the book is an easy read and with something for a wide range of people; local, visiting, young or old. It will grace any bookshelf and those with the foresight to support the project – The Heritage Council, Clare County Council, the Burren & Cliffs of Moher Geopark and the Geological Survey of Ireland are to be congratulated.

**W.B. Davies**

**Banner Rocks** was released at a ceremony last March in The Pavilion, Lisdoonvarna. The author Matthew Parkes was present as was Congella McGuire the County Heritage Officer who has been a driving force behind the project. The book was launched by Cllr. John Crowe, Cathaoirleach and the launch party is pictured.

It was interesting that the press release about the launch, apart from mentioning tourism and education, dwelt in some detail on the practical aspects of geology. This was picked up in a back page article in the Sunday Times where the fact that around 400 people each year, paid for by oil and gas companies, visit County Clare to look at the rocks. This is not an idle exercise because the firms find the county an ideal training ground for staff looking for offshore hydrocarbons to fuel our energy industry. Add to this the many mineral exploration licences at present held by companies in the county and it gives an indication that there may yet be found valuable natural resources either here or nearby. The country surely must welcome such exploration because it holds up at least a possibility of local jobs and a boost to the economy. It will not happen, of course, unless it can be done safely from the viewpoint of the environment and the public. No need for banners, except to welcome such initiatives!

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**NATURAL ART**

**Trevor Edwards** of the Belfast Geologists’ Society

I came upon this sculpture when travelling in Scotland recently. It shows the advantage an artist can take of a natural rock phenomenon to create a special image.

**St. Francis** – by Ronald Rae, Scotland’s leading granite sculptor. Granite: 5x11x3ft, 6.00 tons. Location: On loan to NTS Threave Garden, Dumfries and Galloway.

This emotive work depicts St. Francis lying in retreat on “that rugged rock twixt Tiber and Arno” as Dante described La Verna. The sculpture shows the saint surrounded by the birds that he loved and preached to. Brother Wolf is carved on the other side of the stone. Legend has it that St. Francis saved the village of Gubbio from being ravished of its flocks by persuading the people to feed the fierce hungry wolf. In return for this kindness the wolf became a friend to everyone and a follower of St. Francis and thereafter called Brother Wolf.

It has been written that on this mountainside St. Francis took on the stigmata – the wounds of Christ. In the sculpture Rae has given Brother Wolf the stigmata. Legend also says that when St. Francis died Brother Wolf was at his side.

The St. Francis stone from Tillyfourie in Aberdeenshire is of great geological interest being a mix of pink and silver-grey granite and dark grey basalt. These rocks fused together, not at the whim of the artist but due to injections of molten magma around 470 million years ago! The stone was most certainly cleverly chosen by the sculptor.

**Photographs by Trevor Edwards**
And if you are thinking of holidaying in or near the Alps...

SWISS GEOLOGY
FOR ALL

David Nowell takes us east

The Federal Office of Topography swisstopo has a long tradition of producing outstanding cartography, including publishing geological and related thematic maps of Switzerland on behalf of the Federal Office for Water and Geology. As part of the “Geology for all” project a number of varied publications have been produced. Most notable is Ice and Glaciers - ‘Switzerland during the Last Glacial Maximum’, showing the estimated extent of the ice cover during the last glacial maximum, in the ‘Once and Today’ series (sheet 306), for a relatively affordable 14 ChF (~ £9.30p ~ €11.50c). This is a slightly reduced version of the 1:500,000 shaded relief map Die Schweiz während des letzteiszeitlichen Maximums (LGM) published by the Swiss Geological Survey in 2009 for 50 ChF, the same price as their geological map at the same scale. The glacial map, with contours at 200 m intervals, shows the highest peaks as narrow ridges above the light blue ice. Selected cities and towns are faintly printed beneath the former ice, though oddly not places like Basle, which remained ice free. These areas in light yellowish brown are shown with rivers in blue, though this has been tweaked to show braided patterns along the Rhine and Aare, plus a river linking two ice-dammed lakes along the margins of the French Jura mountains and a channel just west of Schaffhausen skirting a former lobe of the Alpine ice sheet.

Below the popular edition is a brief outline in four languages explaining that the map is trying to depict the maximum extent of glaciation around 24,000 years ago. On the reverse, a short introduction to melting since the Little Ice Age is followed by five case studies. The text does not mention that this is at an accelerating rate, in my opinion most probably linked to anthropogenic global warming, plus the build-up of industrial soot and dust increasing surface warming of snow and ice. Judging by the 2011 photograph alongside the view in 1858, the lower Grindelwald glacier has melted a lot more since my visit in 1978, as the ice no longer passes either side of an outcrop only just visible in the first photograph. These illustrations are underpinned by pairs of detailed topographic maps. Switzerland has even gained a few hectares of territory from Italy, as their frontier has shifted 100 to 150 m southwestwards to a newly exposed rocky watershed at Furggsattel near the Matterhorn, when the slightly higher glacial divide upon which it had been located melted (http://www.swisstopo.admin.ch/internet/swisstopo/en/home/topics/survey/border/moving_boundaries.html).

A Hiking and Geology 5080T Tektonikarena Sardona 1:50,000 map (32-50 ChF ~ £21.60p ~ €26.60c) covering the “Swiss Tectonic Arena Sardona” World Heritage Site shows marked paths or hiking trails with added numbered geological sites. This sheet covers an area south of the Walensee, including Chur in its southeast corner. On the back of what is otherwise standard 50k topography are notes in German about 53 selected sites in a difficult to read font compared to the notes on the margins of recent 50k geological maps for Northern Ireland. Had a larger paper size been used, a tricky truncated third of a panel could have been avoided and there would have been space for this text with room for...
translators and illustrations on the other side. However, Aachen University has posted some interesting notes complete with well-labeled photographs and diagrams at http://www.ged.rwth-aachen.de/index.php?cat=Education&subcat=Alps_Excursion_2013&page=Day_4.

The reverse has a simplified 1:200,000 geological map in twelve pastel tones draped over a shaded digital terrain image, which could have been used on the main map with faint geological boundaries delicately picked out. Without this it is hard to appreciate how the Permian slates (Tonschiefer) and conglomerates (Konglomerat) have been thrust over the local Paleogene flysch deposits produced by erosion associated with alpine uplift as Africa started colliding with the Eurasian plate. A full-color photograph of the Glarner Hauptüberschiebung - Glarus thrust below the Piz Sardona - Surenstock 3056 m and other illustrations could have been better annotated like those in the margins of the Assynt 1:50,000 Bedrock (British Geological Survey 2007) Scotland special sheet in the NW Highlands.

Best of all, swisstopo has produced an excellent Geologie Schweiz, Geology of Switzerland 132 page booklet for those wanting a thorough overview of the incredible diversity of Swiss geological information. This is complete with a wealth of synoptic maps. Each page of illustrations with bilingual German and French keys has an opposite page of explanatory text, though the Italian and English versions are rather abbreviated. These begin with historic maps and then a reduced reproduction of the national 500k geological map at around 1:1,400,000, like many others including drainage patterns, geothermal heat flux, earthquakes, and a series of engaging geophysical images. These cut through the maths and can be enjoyed at an intuitive level, as it is very rare to see a map showing how the strength of gravity g depends on both height and latitude along with the pull of local terrain, before corrections are applied to calculate Bouguer anomalies. A further page shows rates of uplift and sinking relative to their Geneva datum. More conventional extracts show contoured depth images from Swiss lakes, urban ground conditions, flood risk frequencies, landslip hazards, and soils. Other illustrations include a 3D model of the area around Bern and even the preferred locations for nuclear waste disposal beneath northern Switzerland. While a 90Mb pdf version can be freely downloaded, it is worth considering buying a copy for 20 ChF.

Flood risk

POLITICIANS DUCK ISSUES – BUT NOT ALL

Just after a Westminster election and with a Stormont election next year it seems appropriate to mention the ‘ex’ Geology Department at Queen’s University, Belfast. The Head of Geology when it closed, Bernard Anderson, was recently asked by Peter Millar to comment on the truth of the following story:

“I seem to remember you telling me that when the Department was threatened with closure, the staff sent a letter to all Northern Ireland MPs asking for their support in opposing the closure... and the only one who bothered to reply was Ian Paisley, the leader of the Democratic Unionist Party and a creationist!”

Bernard replied:

“Your memory is roughly correct. Somewhere about 1999, after conversations with one or two QUB students and one experimental officer I thought I would, with their help, contact Gerry Adams and the Reverend Dr Ian. I had met Ian Paisley, not for the first time, at the June launch of the GSNI’s 1: 50 000 geological map (Sheet 7) in the visitor’s centre at the Giant’s Causeway. I felt if I got support from both Paisley and Adams that would be the dream ticket which I might be able to cash at Stormont. Sadly Gerry Adams did not respond but Ian wrote a fairly stiff letter to Queen’s new Vice-Chancellor George Bain on House of Commons notepaper and copied the letter and Professor Bain’s rather anodyne reply to me. Professor Bain later referred publicly to the letter, pretending to be humorous but revealing a certain nervousness!

Nothing more happened or if it did I did not hear about it. “

He went on to say “Why do you describe Ian Paisley as a creationist? I know many of his DUP colleagues are ardent creationists but I seriously suspect Ian of being too intelligent and well read.”

Bernard noted to me that other Northern Ireland MLAs and MPs were contacted orally but none felt they could interfere with Queen’s autonomy on an academic matter. That seems weak and inexcusable to me. There is a willingness to make a fuss about many minor things but when something comes up that requires real application and thought it is ducked. Let’s hope those with the titles MP or MLA can do better in future and maybe even question again why a major science was allowed to be lost from its leading university.

Thank you to Bernard for allowing me to publish this little anecdote.

Editor
BOOK REVIEW

Introducing Sedimentology


Can rocks be that red? The first photograph, alongside the Contents, hits you in the eye. They can, and many other colours, as is explained when you read through the first couple of the six chapters. The chapter headings say it all—What is sedimentology?; Sediment to sedimentary rock; Sedimentary structures; The sedimentary environment; Fossils and sediments; The riches from sedimentary rocks. And if that sounds dry don’t believe it because this is a book full of life and vibrancy.

The illustrations, from diagrams to photographs are brilliant. The photographs vary from close-ups to satellite imagery and are taken from around the world. Yet, whilst erudite, the book is genuinely written for students and amateur enthusiasts. It succeeds totally, in my opinion, and even if you are not that enthusiastic as an amateur this will probably lure you into the subject.

New advances over the past decade are described, deriving from improved knowledge of deep-sea sediments through sea-bed imaging, the interaction of climate and sea level as recorded by sediments and recent images of sediments a little further away—on Mars!

The wonders of rocks from around the world are shown and it is in an easy-to-read text. The illustrations come from Canada, USA, New Zealand, Australia, Spain, Iran, Bolivia, South Africa and more. Your reviewer didn’t spot anything from Ireland, so nothing is perfect, but it doesn’t matter. In fact just Wales and a bit of England, mostly Yorkshire, seem to feature from the UK. Probably to be expected when the author is based in Durham and with his name must have some Welsh connection. Three excellent pictures of the Aberystwyth Grits by Denis Bates (who some readers will know) are obviously included to confirm this pedigree.

The final chapter is about the value of sedimentary rocks to society since the Industrial Revolution. Groundwater, minerals and building stones are included but the biggest part of this chapter is given to coal, oil and gas, including shale gas. Like all accounts in the book they are described with simplicity and clarity. The book ends with a very useful Glossary of technical terms.

The book is strongly recommended for school and early year university students and amateur geologists. Although Ireland doesn’t feature, local readers will quickly make comparisons with rocks they see here, from County Down to Sligo, Dingle and Cork. The book should also find a readership in the more general ‘enquiring’ public as well as professional geologists who want a quick up-date.

RAB ▸

PRIMARY SCHOOLS

Earth Science Ireland has been working, with others, on a plan to provide teaching materials for primary school teachers. The materials have to be appropriate for the curriculum. We show just the introductory page of a project that has taken a couple of years to bring together. It is a ‘teaser’ to make you want to look at a fuller article about this work in the next issue. Of course, you can follow it up on-line if you wish and those people involved are always happy to explain more – especially if you are a primary school teacher!
CORALS: a note for beginners

By Patrick Gaffikin

The abundance of fossils in many limestones is a reflection of the fact that their living environment was an attractive habitat... The shells and corals of today are their evolved descendants. Dr. P.S. Kennan – Irish Geologist – from ‘Written In Stone’ (1995).

General

In number, fossil corals are amongst the most common macrofossils occurring in Ireland. Here they are usually most obvious in limestone of Carboniferous age. Corals are invertebrate animals which are, and in the past would have been, exclusively marine. They are classed in the Phylum Cnidaria. They are related to jellyfish, sea-anenomes and hydroids but these are soft-bodied so are much more rarely preserved as fossils.

The living corals

These marine animals can be solitary (single) or colonial (compound). In the former a single polyp ‘sits’ on its exoskeleton (outer skeleton) while the latter consist of a group of polyps – each one ‘sitting’ on its exoskeleton, which is connected to others. The exoskeleton – called a corallite - is composed of calcium carbonate (lime), built by the polyp, and which is absorbed by the polyp from sea water. It provides protection for the polyp. At the polyp’s free end there is an opening surrounded by retractile tentacies which have the ability to catch food and sting prey. Polyps are not usually preserved as fossils because they are made of soft (jelly-like) tissue. Corals are sedentary – mostly living on the sea floor anchored to rocks – but their larvae (infant forms) are mobile (free-swimming) for a few days. Corals are found throughout the oceans from deep cold to shallow tropical waters. Most coral reefs are restricted to warm seas and depths to which light can penetrate. An example of the adaptability of corals is a small solitary coral called Caryophyllia found at low tide near Strangford Harbour in County Down. It is known to tolerate temperatures of just under 3°C and can live at depths up to nearly 2,500 metres. The study of living corals can throw light on our understanding of fossil forms.

Corals in the past

Corals evolved in the early Ordovician Period (around 480 million years ago) but suffered badly in the mass extinction at the end of the Permian Period (around 250 million years ago). They are thriving today.

What fossils of corals can tell us

Fossils can tell us the age of the rocks in which they occur but some allow more accurate dating than others. Many corals evolved slowly so individual species lived for a long geological time. This means, from corals, we are commonly unable to narrow-down the age of the rocks in which they are found. For example the...
coral fossil *Michelinia sp.*, lived between the Late Devonian and Late Permian – a time span of around 115 million years. Another qualification that a fossil requires in order to be useful for dating and correlating rocks is that it should have a wide geographical distribution. Corals are relatively stationary on the sea floor so tend to be regionally restricted. This results in different forms (genera and species) being confined to comparatively small areas.

So corals are poor for accurate age dating but good for telling us about past environments. They can give an indication of the temperature of the water in which they lived but this is by comparison with modern forms.

**Corals past and present**

Today’s living corals are the evolved descendents of the fossil corals. They may prove to be indicators of the health of our oceans as the influence of people impacts on the environment. Coral reefs support much marine life so their sustainance is important. Perhaps the best example of a fossil coral reef (certainly in Ireland) can be seen in County Sligo at Streedagh – see picture – where it is known as ‘serpent rock’ because the huge individual corals look like snakes. As you tread over the rocks of Carboniferous age on any beach look out for corals like those illustrated here. Imagine those warm tropical seas and if you want to follow it up speak to someone at your local museum.

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**THE IRISH LANDSCAPE**

An All-Ireland Exploration through Science and Literature

*By Peadar McArdle*


W. B. Yeats once said that it was his ambition that we would regard our local landscape as exciting. He was, of course, talking about the quartzite mountain, the limestone-floored lake or the sandstone ridge. But he meant much more than that. Is a warm hillside in summer the same as when it suffers a dark wintry storm? Surely our perceptions are shaped as much by our emotional response as by a hill’s physical make up. The geologist may have mastery of the rock but it is the poet who opens our minds to a more inclusive understanding.

In this fascinating study, former Geological Survey of Ireland Director Peadar McArdle shows how Patrick Kavanagh creates the link between Monaghan’s steep drumlins and the harsh parsimony of its people. The warm nostalgia of Oliver Goldsmith’s Auburn may find its origins in the Midland’s rich farmland. Bogs were for long considered the domain of the backward, but now, thanks partly to Seamus Heaney’s enriching insights, their image has been transformed to that of a cherished habitat. Louis MacNeice thought that Belfast’s dour basalt reflected the character of that city’s Protestants and, further south, W.B. Yeats considered that his childhood limestone influenced the simple charms of its inhabitants. This captivating, county-by-county exploration will deepen and enhance our appreciation of Ireland’s remarkable landscape and the impact it has had on Irish history and culture.

(Editor – the above is taken from the press release issued by the publisher. ESI hopes to have a copy to review for the next issue. If anyone would like to undertake that review please contact me)
Explore Galway’s Buildings in Stone with the new NUI Galway Guidebook

A new guidebook has been published by NUI Galway’s discipline of Earth and Ocean Science highlighting the wide variety of local and imported natural stone used in Galway City’s buildings.

The three walks tour highlight the wide variety of local and imported natural stone used in the City’s buildings. The map displays the locations of the buildings described along the course of each walk. The three chosen walks are as follows: **Walk N1 West of the River Corrib** starts at NUI, Galway and includes Galway Cathedral, The City Museum, Spanish Arch and Blake’s Castle. **Walk N2 Galway City Centre** highlights the buildings along Quay Street, High Street and Shop Street and includes St. Augustine’s Church, St Nicholas’s Collegiate Church and Lynch’s Castle and **Walk N3 Eyre Square Area** includes the Allied Irish Bank and Bank of Ireland buildings, Meyrick Hotel and the Railway Station.

The city’s building stones display a variety of textures and fossils that reflect their geological origins. In addition, we can see the effects of weathering on the city’s building stones such as rock weathering and water dissolution products growing on our limestone buildings. The tour can be followed by our city’s visitors and geologists alike and will prove very useful for urban fieldwork by primary, secondary and third level student parties. Furthermore, it provides an opportunity to study rocks from around the globe e.g. China, Finland, Portugal, Italy, South Africa, Norway, Brazil, England and of course Ireland in a matter of a few hours. The book is an invitation to enjoy learning about the geological heritage that surrounds us in Galway’s inner city.

The authors would like to thank Dúchas Na Gaillimhe - Galway Civic Trust for assisting with the publication of this book and in particular Delo Collier for her encouragement during the course of this project. Local Historian, Mr. Tom Kenny, launched the new guide book, the three walks tour highlight the wide variety of local and imported natural stone used in the City’s buildings. The map displays the locations of the buildings described along the course of each of three walks.

Galway City Walks Buildings in Stone was compiled by NUI Galway’s Professor Martin Feely and Dr Alessandra Costanzo and contains an accompanying street map displays the locations of the buildings described along the course of each walk. The three chosen walks are as follows: **Walk N2 West of the River Corrib** starts at NUI, Galway and includes Galway Cathedral, The City Museum, Spanish Arch and Blake’s Castle, **Walk N2 Galway City Centre** highlights the buildings along Quay Street, High Street and Shop Street and includes St. Augustine’s Church, St Nicholas’s Collegiate Church and Lynch’s Castle and **Walk N3 Eyre Square Area** includes the Allied Irish Bank and Bank of Ireland buildings, Meyrick Hotel and the Railway Station.

The city’s building stones display a variety of textures and fossils that reflect their geological origins. In addition, we can see the effects of weathering on the city’s building stones such as rock weathering and water dissolution products growing on our limestone buildings. The tour can be followed by our city’s visitors and geologists alike and will prove very useful for urban fieldwork by primary, secondary and third level student parties. Furthermore, it provides an opportunity to study rocks from around the globe e.g. China, Finland, Portugal, Italy, South Africa, Norway, Brazil, England and of course Ireland in a matter of a few hours. The book is an invitation to enjoy learning about the geological heritage that surrounds us in Galway’s inner city.

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MEDAL OF HONOUR

The Institute of Geologists of Ireland (IGI) awarded its prestigious Medal of Honour for 2015 to EurGeol Kevin Cullen PGeo at a ceremony in Dublin after its Annual General Meeting on 26th May.

Kevin Cullen received his B.Sc. (Hons.) degree in geology from University College Dublin in 1971 and obtained a Master’s degree in Hydrogeology from Birmingham University in 1978. He has practiced as a professional geologist in Ireland since 1971, firstly in mineral exploration and subsequently in hydrogeology and waste management. Kevin founded the consulting practice of K. T. Cullen & Co. Ltd in 1979 which was subsequently acquired by White Young Green plc (WYG) in 2001. He remained with WYG as managing director of the Irish Environmental Unit until 2004. Since 2004 Kevin has been self-employed, consulting in the area of hydrogeology and environmental geology.

Kevin’s wide range of hydrogeological experience includes dewatering of mines and quarries; the development of groundwater for industrial, mineral water, the agri-industry, electronic and leisure industries; the hydrogeological assessment of landfill sites; expert witness at oral hearings and court cases; and identification and development of public groundwater supplies. Throughout his career he has contributed to many planning applications and Environmental Impact Statements (EIS).

Kevin is currently a Non-Executive Director of The Verde Environmental Consultants Ltd.

Kevin has been a loyal and dedicated Member of the IGI as well as an ardent supporter of the European Federation of Geologists. He served on the IGI Board and was President from 2007 to 2009. He has contributed to many IGI projects including the Institute’s EIS and Private Water Well Guidelines and to various workshops. He is always available to provide advice and volunteer for IGI activities and assists with interviews hosted by the Validation Committee.

Earth Science Ireland adds its congratulations to Kevin on this well-deserved award.

Prof. Martin Feely and Dr. Alessandra Costanzo
Earth and Ocean Sciences
National University of Ireland Galway
PASSING ON KNOWLEDGE

Karen Parks, a senior teacher at Methodist College, Belfast and regular contributor to this magazine, reminds us about the importance of passing on knowledge and making geology fun. The teachers need the knowledge to be passed from one generation to another and from professionals to amateurs. The students need the subject, at least in part, to inspire an interest and give enjoyment – fun.

She sent the photograph which we show here of two of our most senior professionals leading a Belfast Geologists’ Society trip to Ballintoy in County Antrim. Karen still uses information picked up on such trips in her teaching both in the classroom and in field studies. There is no way teachers have time to seek out field localities to take students and the professionals know where the real gems lie.

One of those professionals is no longer with us, the still much missed Philip Doughty who in his museum job never failed to engage young people. The other is Paul Lyle, who is author of the most popular geological book on the Giant’s Causeway. Paul has just had a new knee so this is the time to get him back out onto those favourite rock sections and also to quiz him about the spectacular books he has written for the interested public about Northern Irish geology.

Making the subject fun can include baking and there has been a baking competition held by the Geological Society of London. The same organisation has also promoted GeoBingo – but more about that in a future issue of this magazine.

LETT E R TO THE EDITOR

Sir, As mentioned in Issue 16, Angus Kennedy wrote an open letter in response to my article “Reading between the (basalt) columns” in issue 15 (p.30-1), in which I debunked creationist nonsense about Antrim’s Interbasaltic Bed. Angus’s letter, and a report by Tasman Walker on a creationists’ field trip to the Giants Causeway covering the same topic, can be found on the creation.com website (search on Giant’s Causeway, and look for articles dated 23 November & 14 December 2014).

I’ll not debunk here the further errors Angus & Walker make, it is obvious to an impartial reader that Angus’ letter is an exercise in missing the point and irrelevance, with some implausible chemistry thrown in. But it is worth remarking that, in spite of Angus’ assurance (Issue 16, p. 16) that comments would be allowed, and indeed a few were, in each case my final comments were barred. I have found before that creationists don’t like being pressed on points they have failed to answer properly. This should be remembered next time they complain about censorship. To see what the creationists don’t want you to, visit the forum of the British Centre for Science Education (bcseweb.org.uk) and search for “Tas Walker debunked again”.

Lest anyone queries the coverage given to this issue, the need to do so is illustrated by a post following Walker’s 14 December article. The poster remarked that he had visited the Causeway and, using Walker’s materials, had spent half an hour challenging some unfortunate guide who “admitted the standard ‘story’ had issues and couldn’t answer some questions we raised. Seeds were sown that we trust the Lord will bring to fruition.”

If the guide had read my article the outcome would probably have been very different.

Yours sincerely, (Dr) Stephen Moreton

Editor
BALLYCLOGHAN BOREHOLE & THE COAL QUESTION

_Ireland’s first diamond drill hole_  
_By Alastair Lings_

Ballycloghan is a townland in County Antrim, six kilometres north east of Ballymena. The Antrim Lava Group forms the bedrock of the townland, with the Lower Basalt, Interbasaltic and Upper Basalt Formations represented. At the small hamlet of Quarrytown, the Lower Basalt has been intruded by rhyolite (1). The rhyolite has been described by Symes and Hull (2), and Cole (3); and a chemical analysis given by Meighan and others (4). Geophysical data indicates the rhyolite is part of a circular volcanic plug, roughly 1.5 kilometres in diameter (5).

As the name Quarrytown suggests, the rhyolite has been worked. The first mention being in 1816: “at Ballycloghan, two miles north-west from the village of Broughshane, there is a bed of clay porphyry extending towards Slieve Mish on the south-east; it is quarried as a freestone, and when raised in thick slabs, is used for window seats” (6, p191). The quarry is marked on the first edition six-inch to one mile scale map of the Ordnance Survey, 1831-1832, but not on later maps. Lieutenant R. Boteler of the Survey recorded “Hard, white claystone and porphyry appears close to the schoolhouse...It is quarried and used for windowsills” (7, p105).

In 1870 Kelly (8, p295) described the quarry as “a protrusion of whitish fine-grained rock, which is quarried and cut for window sills and other economic uses in the country. A quarry is opened in it at the National Schoolhouse, and worked to the extent of half an acre. The rock...has a vertical cleavage, by which it splits into flags from two to four or six inches in thickness, and is easily worked with punch or chisel.”

The discovery of iron ores in the Interbasaltic Formation raised the question whether coal was present in the area around Belfast (9). On the 22nd November 1871 William Gray, an architect with an interest in geology (10), addressed a meeting of the Belfast Naturalists’ Field Club on the possibility and probability of finding coal in the neighbourhood of Belfast (9).

In September 1872 newspaper reports on the supposed discovery of coal near Belfast prompted Mr Gray to challenge the reports, writing to the Belfast News-Letter “I have no hesitation whatever in declaring that there is not the shadow of evidence to prove the existence of coal near Belfast” (11).

Between the 30th September and the 14th November Mr Gray wrote ten short articles for the Belfast News-Letter entitled “Our Coalfields”. During this period there were public meetings in Larne (12) and Newtownards (13) to discuss exploration for coal, to which Mr Gray contributed. His final article on “Our Coalfields” discussed the possibility of finding coal beneath the “New Red sandstone” by drilling a borehole “to a depth of at least 1,500 feet” using “a diamond rock-borer” from the Machine Tunnelling Company (14).
“COAL TREASURES NEAR BROUGHSANE. - It is believed, on trustworthy evidence, that a mineral coal-bed, of astounding extent, has been discovered on Shane’s Castle estate, at the Freestone Quarry, near Broughshane, and only four miles distant from Ballymena. A steam-engine and testing apparatus, supplied by the London Diamond Boring Company, are now in operation upon the premises, under the superintendence of a competent engineer in the employment of Lord O’Neill. According to scientific theory, it is confidently affirmed that the search will result in the discovery of four separate seams of coal, directly underneath each other, and at the following distances from the surface: - 1st seam; 120 yards, thickness 8 feet; 2nd, 135 yards, thickness 5 feet; 3rd, 145 yards, thickness, 2½ feet; 4th, 153 yards, 2½ feet. The expense incurred in the investigation will be considerable – we understand that the boring will cost about 20s per foot; but, if the present expectations are realised, the value of the deposit as regards the proprietor, and these watchful men and this engine, can hardly be overestimated. – Ballymena Observer. “

The news elicited a scathing response on the 26th March from Mr Gray (16):

“No “trustworthy evidence” or “scientific theory” would justify so bold an assertion as is here made – that coal to the thickness of 18 feet occurs within 153 yards of the surface. The simple fact is, that an explorer would be just as likely to find coal on the top of Cave Hill as the spot selected for boring near the Freestone Quarry near Broughshane. The very same beds occur there as at Belfast – viz, trap rock, then chalk, then red sandstone, and possibly the carboniferous rocks at a depth of some 2,000 feet. But I will venture to affirm that no coal will be found nearer the surface, except perhaps a bed of lignite, such as occurs at various place around the locality; and even at 2,000 feet it is very questionable whether the carboniferous rocks will be reached, and if they are, it is not certain that they contain coal...it is utterly absurd for any man to predict the number, thickness, or depth of possible coal-beds under such unpromising circumstances.”

Drilling commenced at Ballycloghan on the 7th of April 1873 (17). The Northern Echo describes the process in the northeast of England (18):

"Prospecting" with the diamond borer.

Ceaselessly, in Cleveland, new fields are being sought for iron. It matters not, therefore, to state the exact locality in which we witnessed the process of boring or “prospecting” for minerals by the Diamond Rock-boring Machine. Our readers, heretofore, have been made acquainted with the ingenious invention, patented by Major (then Captain) Beaumont; and they know that the invention has become the property of the Diamond Rock-boring Company – of which the gallant junior member for South Durham is the managing director.

The implements for boring hundreds of feet from the surface are very simple. There is a pair of sheer-legs, with pulleys and ropes, above the bore-hole and the borers; near these are reeling some score of pipes for lining the hole, and as many bore-rods, each some ten feet long, a wooden hut on the one side, and on the other a wooden covering for the portable engine; these with the long line of pipes used to bring water for “washing” purposes from a “beck”, and for “washing” purposes from a “beck”, there as at Belfast – viz, trap rock, then chalk, then red sandstone, and possibly the carboniferous rocks at a depth of some 2,000 feet. But I will venture to affirm that no coal will be found nearer the surface, except perhaps a bed of lignite, such as occurs at various place around the locality; and even at 2,000 feet it is very questionable whether the carboniferous rocks will be reached, and if they are, it is not certain that they contain coal...it is utterly absurd for any man to predict the number, thickness, or depth of possible coal-beds under such unpromising circumstances.”

There is a grinding noise, a puffing of the engine, a rattling of machinery, a settled watchfulness on the part of the men – and that seems all there is to describe! By questioning, I learn the mystery; and, later on, I see it brought to light. The “borer” itself is a hollow iron crown or cylinder set with diamonds – in this case some two inches in diameter, producing an 1¼ core; but I have seen a core four inches diameter by a foot long. The crown revolving at a speed varied according to the nature of the strata through which it cuts, brings out a “core” or section of the strata, in lengths varying with the nature of the strata. And this, we think, is the great advantage of the “Diamond” over other borers; and thus the cores extracted by the “core tubes” attached to the crown and bore-rods become the registrars of the strata. Of nothing am I reminded by the process so much as the taking of a “core” of cheese, therefrom by a cheese-taster! The earth is the cheese – a trifle underdone in some place, overdone elsewhere, according to geologists, - the “Borer” is the taster, and these watchful men and this engine stand in the place of the cheesemonger.

A sample of the core was exhibited at a meeting of the Belfast Naturalists’ Field Club on the 23rd April (19).

Drilling continued until the 24th May, reaching a depth of 558 feet and 5 inches (170.21 metres). Unfortunately there was “Nothing of value discovered” (17, p379). This must have been a great disappointment to the people involved in the drilling operation, including R.A Watson, who had been employed for two years, looking for iron ore on the estates of Lord O’Neill and Sir Edward W. Macnaghton (20). Watson wrote, from Cumberland, to the proprietor of the drilling company (17, p378-379):

“Dundraw, Wigton June 2nd, 1873.

To Major Beaumont, R.E., M.P.

“Dear Sir,

“I feel that I should not be doing my duty to the Diamond Rock-Boring Company, without adding my testimony as to the speed, excellency, and satisfactory manner with which your Prospecting Machine (No. 14) has done its work for me in Ireland. The Borehole at Ballycloghan was commenced on the 7th of April and completed on the 23rd of May, when a depth of 558½ feet was reached, the
whole of which was bored through hard basalt and whinstone; during this time the machine was ordered to stop for a week for consultation with another gentleman as to the advisability of going deeper; and, allowing for this, and also Sundays and wet days, the daily average was within an inch or two of 20 feet per day, and upon two days a depth of over 40 feet each day was bored at one time, and in the presence of myself and several other gentlemen, the machine was boring at the extraordinary speed of 3 inches per minute (whinstone.) An enormous quantity of core was daily extracted, and a complete section with perfect specimens was easily made. I may add I hope soon to require another machine or two to bore near here and in Scotland.

“I am, yours very truly,”

“(Signed) “R.A. Watson, C.E.”

In July 1873 the Belfast Naturalists’ Field Club visited the quarry, and subsequently reported on the borehole (21, p16-17).

“From Broughshane the party went to Ballycloughan, so-called, “freestone” quarry. The stone of this quarry was supposed to be a freestone, or sandstone, and, as such, connected with the coal measures; and for a long time past the people of this locality believed that the coal existed there not far from the surface. This opinion was confirmed by a mining engineer, who predicted that several beds of coal would be found at certain depths; he even gave the thickness of the beds supposed to occur within 400 feet. These favourable prospects cheered the whole country, and the farmers of Carncoa told how they frequently raised coal in their lands when turning up the soil for farming purposes, &c. When this information was published here, a member of the Belfast Naturalists’ Field Club stated point-blank the whole affair was a mistake; that no coal was ever found in the locality, or ever would be found; that the supposed “freestone” was not freestone, but a variety of porphyry, and that if a boring was made the borer would only find what could be had on the Cave Hill - common trap rock; and thus, at an expenditure of hundreds of pounds, the predictions of the mining engineer were proved unfounded, and the opinion of the member of the Belfast Naturalists’ Field Club demonstrated to be correct. It is only to be regretted now that the landlord’s liberality and the boring company’s most efficient apparatus did not secure better results. This was the first boring made by this company in Ireland, and probably the severest test the apparatus was ever put to, inasmuch as it had to bore through solid trap rock for the entire depth; yet it went down steadily, often thirty feet per day, and brought to the surface from all depths, even to 558 feet, not muddy debris, like the ordinary jumper, but solid cores of the rock passed through; so that by this wonderful apparatus a boring can now be made in as many days as it took months before, while the resulting cores give actual samples of the several strata passed through, whether soft as clay or as hard as granite. Having obtained specimens of the cores of trap rock brought up by the borer, and expressed their regret at the failure of the undertaking, the party left for Glenravel.”

Because the Diamond Rock-Boring Company were pioneers in the use of this new equipment (18), and this was “the first boring made by this company in Ireland” (21, p17), the borehole was probably the first in Ireland to be made by diamond drilling.

Sadly this pioneering borehole was soon forgotten. Neither the borehole nor the “Freestone” quarry were mentioned by Symes in 1886 (2). Ten years later Cole recorded “A good quarry was worked here in former times for window-sills, &c.; but there are now several respectable larch-trees growing in its floor. An old man whom I met remembered working in it, and told me, as one often hears in the county of
On the 21st of August 2014 the flow from the borehole was drilled to a total depth of 2272 metres (7454 feet) at Ballymacilroy, eight kilometres south-west of Ballymena (24). The hole was drilled through 769 metres (2523 feet) of lavas, but was ended before intersecting potentially coal-bearing rocks.

Acknowledgement. The author is very grateful to the landowner, James Scullion for his help on-site.

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Walk - with Wonder

with David Kirk

We, the humble amateurs, are often green with envy when we read or listen to the accounts of our professional peers travelling to exotic and geologically rich and dramatic regions of the planet for ‘important research’ (Yeah, right!) while we have to settle for hoking round the shores and mountains of our ‘home’ territory looking for something new to get excited about.

But think a bit deeper - literally. Do a bit of homework and you will realise that even the most seemingly mundane of landscapes beneath your feet are as they are because of a long and often dramatic geological history. As you walk, think of the story beneath your feet.

Take just a small example, Stormont. This elegant and beautifully maintained parkland, overlooking Belfast’s leafy eastern suburbs, is the epitome of cultured gentility. Every week people make some 6,000 visits - walking or running its smooth pavements, along its gravelled woodland paths or across its spreading manicured lawns, exercising their dogs, pushing their prams and enjoying the changing vegetation through the year - but mostly never appreciating that their feet are walking across 450 million years of their planet’s history!

Stormont’s slopes and manicured and colourful gardens swathe down through the rich farmland clothing the southerly slopes of Craigantlet hills, and then, like a children’s slide, level out across the flat bottom of the Dundonald Valley.

It is usually seen just as the setting for the dignified building created as the seat of Northern Ireland’s legislature - a spreading skirt for the grand lady on the hill. But beneath its manicured slopes there is more to it than that.

The geology map of Northern Ireland shows a straight line running roughly west-east just behind Parliament Buildings. East of it a right-angle turn southwards marks the line of a later tectonic movement, following (or dictating) the line of the second of two great river glens carved from the hillside in Stormont Estate (sadly not currently open to the public even though a pathway to it was created some years ago) before turning east again, skirting Scrabo’s ‘young’ dolerites and then curving a short distance inland from Strangford Lough’s eastern shores - through Mount Stewart’s gardens - and finally disappearing under the water between Greyabbey and Kircubbin.

This is the line of what is known as the Newtownards Fault, the remnant of a great rifting of the earth’s crust that created a valley which could have been up to a kilometre deep. Today it marks the diving line between the 450 million year old hard Silurian rock of the Craigantlet hills and the 230 million year old Triassic sandstone which filled this valley - and from which the Dundonald Valley was gouged out by the great ice-sheets that have come and gone over the past two million years.

The ice also left the hillsides and valley floor ground plastered with thick layers of clays, and later sands and gravels from which today’s landscape has been sculpted.

A Geological Survey Memoir accompanying the 1904 map of glacial drifts around Belfast state that a 19th century gravel pit - now long overgrown - on the side of the glacial ridge covered with pine trees at the west edge of the park, known as Castle Hill, revealed the ‘drumlin’ was built of alternating layers of boulder gravel and sand. (There is a similar hill on the east of the park, also now a pine-grove). The gravel contains stones, some very big, from far and wide, such as basalt and flint from North Antrim, red jasper, Eurite (the rock of Ailsa Craig), granites from Scotland’s mountains as well of course many of Triassic sandstone, not so far from home.

Stormont’s West Glen, gouged out of the hillside by torrents of melting ice-water.
Much of the lower levels of the park lies on deep boulder clay covered with a thin layer of gravely soil washed down from the hills above by the melting ice. These torrents also carved out the deep glens, the most dramatic of the Park’s features, which today’s streams would never have had the power to do. Below a short steep section at the head of the glen, marking the boundary between the hard greywacke and the softer sandstone the present stream follows a gentle downward course while the ground on either side rises steeply, creating a dramatically deepening feature.

A couple of decades ago it was possible to explore the glen by ‘boulder-hopping’ up the stream bed but barriers of fallen old tree trunks and limbs have made this more challenging.

So there it is. We all know the drama behind our geological ‘stars’ - the Giant’s Causeway, Scrabo, Marble Arch, the Mountains of Mourne - but remember, the ground beneath your feet will always have a story to tell. Walk with wonder.

*This article is based on an extract from the author’s forthcoming book ‘The Land of Stor’.

Erratic stones from far and wide pack the glacial clays that coat Craigantlet’s lower sandstone slopes, revealed in the Glen’s streamside.

Another stimulating year for Belfast geologists

by David Kirk

It was another wide-ranging - in fact planet-ranging - winter of talks for Belfast Geologists’ Society members, with good attendances for all meetings.

In October Professor Jim Floyd from the British Geological Survey opened up the world of the geology of the Cape Verde Islands and in November Dr Dave Chew gave an illuminating talk on the tectonic evolution of the Laurentian Margin in North West Ireland and Scotland.

The mysteries of what lie beneath the basalt covered basins as far apart as India and Ulster were uncovered in December by GSNI’s Dr Rob Raine.

Unfortunately family illness prevented Dr Adrian Finch of the University of St Andrews giving the planned lecture in January but our past-President Dr Ian Meighan stepped in with a very polished lecture on the Newry and Mourne granites, rounded off with remarks on the archaeological aspects of these granites. (This isn’t the first time that Ian has come to the Society’s rescue at very short notice; in March 2012, he substituted for another absent speaker).

The search for what previously frozen ground can tell us about the environment of periglacial Ireland was described by Dr Sam Roberson of the GSNI in February.

While not part of the mainstream BGS lecture series - although sponsored by the Society - February also featured the Memorial Lecture in honour of one of its most revered late members - Philip Doughty. The annual Irish Geological Research Meeting lecture series being held in Belfast was an appropriate event in which to honour Philip and his lifetime’s work and support for the Society. ‘How To Make a Dwarf Mammoth’ was the title of the entertaining - and informative - lecture by Dr Toni Herridge who took a tour through the weird world of ice age islands, exploring how and why dwarf elephants evolved and how evolution can be more predictable than often thought.

In March Professor Donny Hutton from the University of Bristol delivered our annual Harold Wilson Memorial Lecture with an enlightening overview of the complexities of the Donegal granites.

And another geo-exciting summer can be looked forward to, In fact, by the time you get this it will be well under way. Members will have seen ‘rocks galore’, the volcanic centres of Slieve Gullion and Cooley, several sites near Dungiven and checked out the building stones of the Cathedral Quarter of Belfast.

Coming up will be ‘abandoned mines and landslips’, kinks, dykes and cleavage’, stones in store at the museum and a longer trip to Sligo. See the web site: www.belfastgeologists.org.uk for details.

www.belfastgeologists.org.uk
Galway Geological Association Chairman’s Report January 2015

This year we strove to work with other groups in the promotion of Geology. We held our first joint event with GEOS last year and we look forward to holding two joint talks in the coming year.

I spoke to acting IGA President Patrick Royson and he explained that the memberships of IGA are interested in more events outside Dublin. Currently they book a speaker to give a number of talks in different regions within the same week and are very much tied to the speakers’ diary. Therefore sometimes the arrangements will not be ideal for GGA. However he took our concerns on board and expressed a desire to work harmoniously with us.

Earlier this year we organised a survey of members and received almost 50 responses suggesting the number of field outings and public talks held during previous years was about right. The coming year has an additional field trip added to our calendar of events. Last year saw the first GGA pub quiz and we got a very positive feedback from this event with respondents requesting that an additional social event should be added to our calendar. This will happen in April/May 2015 and we are open to suggestions for this event but a film night is the only suggestion we have to date. Respondents to the survey also expressed a demand for the GGA to organise more Geology classes. Their replies showed a preference for the 4 week courses and the stand alone Saturday classes rather than the 8 week long module option. To date all classes have been well attended. I believe these courses are essential to the GGA as a follow up to the diploma course that many members have undertaken or completed; and as a way of attracting new members to the GGA.

I believe Heritage Week provides a great opportunity to promote the GGA and attract new members. Membership is the lifeblood of our organisation and I believe that to maximise potential future membership I would suggest our Heritage Week event must be able to cater for all comers. Another idea would be to create the office of Registrar in the GGA in order to have one person exclusively concerned with attracting new membership. I attended the last IGA talk and the turnout was equivalent to one of our smaller attended talks but was comprised of mostly non-GGA members; this may suggested there is an audience out there that we are not attracting. Similarly the fact that we are attracting few members from the last or present diploma course suggests that something is amiss which I believe we must address in the coming year.

In the past year we successfully organised 2 field outings and 6 public talks and held a successful Heritage Week event in Salthill. This year we decided to plan a 12 month calendar of events and I believe this has given greater coherence and to our group’s activities. While everything did not work perfectly to plan I believe this approach will help promote the GGA in the longer term. The GGA is a very young organisation but we are gradually improving our systems.

Seamus McGinley

(Editor – the above abbreviated report, includes ideas that might be helpful to other similar amateur groups. GGA is to be congratulated on moving ahead as it is – all power to its elbow)

A NEW EDITION OF THE CAUSEWAY COAST GUIDE


The new edition is the same size as the previous editions (about 14.5cm wide and 21cm long), which is handy for a large pocket, but is 142 pages long compared with 90 pages. This increase of 52 pages means, as you would expect, more information. There is, for a start, a whole new section on conservation.

Unfortunately your editor couldn’t find a reviewer in time to do this book justice. It makes Paul Lyle probably the best selling geological author on the island. If you are visiting the Giant’s Causeway you must get a copy of this edition. A glance through shows there are new things described and some fresh photographs.

Don’t wait to get a copy but we will review it in detail in another issue. Why should we take time on this? Answer - because the book is at the ‘face’ of geology for the general public.

And the price? A major plus because it is not going up and at £8.50 has to be a snip.
BOOK REVIEW

Introducing Mineralogy


The book contains seven chapters (titles abbreviated): 1 – Basics (background science); 2, 3 – Typical, atypical mineral occurrences; 4–6 Mineral collecting, studies, uses; 7 – Minerals and environment. Overall, the compositions, structures and properties of many common, and some rarer, minerals are described, together with assemblages characteristic of the common rock types. Of the 118 text pages some 17 concern aspects of mineral collecting (sites, ethics, storing, buying, etc., p.56–72) and 10 are on commercial ore exploitation and ornamental minerals (p.87–96). The back-cover promotional paragraphs identify no particular audience for this book but perhaps the title itself suggests students and amateurs as the prime targets. The book has many well-reproduced colour pictures and anyone new to mineralogy will find the book interesting for these alone but I do have serious misgivings about some of the facts given and outline these below:

Chapter I, ‘The basics of mineralogy’ (24pp.), presents the relevant background science. Headings include: mineral definition; elements and compounds; chemical bonds; crystallization; crystal systems; mineral textures; (various) properties; naming; classification. This is an ambitious coverage in only about 7,500 words and there are some important shortcomings in explanations of the science. These apply particularly to descriptions of chemical bonds and to classification of silicate mineral structures. Such limitations in explanations of the basics of mineral science hinder understanding of many aspects of mineralogy.

Chemical bonds (p.5). Ionic and covalent bonds are neither precisely defined nor adequately distinguished. The undirected character of ionic bonding is insufficiently developed, whereby crystal packing/structure is determined by relative sizes of ions and their shapes. The former is not discussed for the structures in Fig.1.3. Later, it is stated: ‘.....the sulphate anion.....is joined to the calcium cation by ionic bonding....’. (My italics.) Ionic bonds do not join specific neighbours. Again, the directional character of covalent bonds is not fully explained; it is necessary (e.g.) to understand bonding in quartz, Fig. 1.1. The relative weakness of hydrogen bonds is not mentioned.

Crystallization (p. 5). Although references are made to the several types of silicate crystals (ionic, chain, sheet and framework) the importance of these structural features in classifying natural silicates, and their properties, is not adequately developed. Moreover, the dual role of aluminium, as a cation [Al3+] or by [AlO4] replacing [SiO4] tetrahedra in silicate minerals (with charge change) is not explained. I have concerns about whether the basics in Chap. 1 provide sufficient foundation for the full understanding of Chap. 2, etc.

X-ray crystallography theory (unexpectedly) appears in Chap. 4, ‘Mineral collecting’.

Illustrations. The book is copiously illustrated with 87 well-reproduced colour pictures, though many lack a scale. However, the specific features identified as of interest are not always obvious. Examples: I found no bipyramids in Fig. 1.5 (see: three lines up); shapes of ‘dark crystals’ in Fig. 1.10 are difficult to discern; etc.

Other. Gypsum is a dihydrate and the (incorrect) dehydration equation given (p.93) does not balance: 4CaSO4∗4H2O = 4CaSO4·H2O + 3H2O. Later: CaCO3 = CaO + CO2. Other errors and misprints were found.

I regard these, with other shortcomings in the science, as reducing the overall value of this book as ‘Introducing Mineralogy’.

Andrew Galwey

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Issue 17
VIEWPOINT

Barry Long assesses a climate change lecture

On 28th May 2014 I attended a public lecture in central Dublin entitled ‘Climate Change Now: the Facts.’ It was one of a series put on by the Environmental Protection Agency and very well attended. The speaker, Professor Thomas Stocker, is lead author of Climate Change 2013, The Physical Science Basis, Working Group 1 Contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC WG1 AR5). You can watch the lecture here: https://www.youtube.com/watch?v=EGSZ7Gus6T8&index=43&list=PL8330E2D84D07F156.

The title suggested, and I hoped that I would hear, the facts of climate change; I was disappointed. The word ‘Now’ in the title was used to justify climatic events and features mainly from the recent historical past being presented in isolation as unusual or extreme. I felt it lacked the context of a longer time frame and was dismissed in seconds. Even ancient ice ages and cycles upon cycles, were not addressed and ancient ice ages were dismissed in seconds. Even the Pleistocene ice age with its long glacials with interspersed shorter, warmer interglacials. The Pleistocene Epoch ended 11,700 years ago at the end of the last glacial. Since then, the Holocene interglacial temperature rose to a peak 7,850 years ago followed by a general decline to today, with superimposed fluctuations attributable to natural cycles of various lengths. Pieces of 4,000 years old trees are exposed at the leading edge of a Swiss glacier. The Alps were largely glacier free in Roman times. In temperate zones the Holocene interglacial was, and still is, climatically benign. It has spanned the entire development of human civilization and it can be argued that it is now trending towards the next long glacial.

2. IPCC computer models are used to generate short term temperature projections. They show global warming occurring at a rate claimed to be faster than at any previous time. Professor Stocker conceded that earlier projections were on the high side but said that improvements have been made.

Successive short term temperature projections from demonstrably flawed IPCC computer models have been shown to be significantly above temperatures eventually measured and they continue to diverge further from instrumental values. Model outputs are not evidence. The many projections all failed to predict the lack of warming for the last 17 years. Nevertheless, the projections are central to IPCC forecasts of global warming and have been uncritically used by governments to formulate energy policy. Regular instrumental temperature measurements span only about 160 years, with Central England records from 1659 spanning twice as long. Meaningful conclusions cannot be drawn from such short periods. The IPCC ignores empirical evidence showing that late 19th and 20th century warming was well within the range of earlier natural change, and that its rate of change was slower than that associated with the ending of the cold 1,100 year-long Younger Dryas about 11,500 years ago. Acknowledging that its earlier temperature projections were substantially too high, it is softening some of its earlier harsh warnings.

3. Regular modern measurements of atmospheric carbon dioxide concentration
over the last 56 years show a steady though fluctuating upward trend to almost 400ppmv (parts per million by volume) today. On a graph shown spanning 800,000 years, CO2 had remained below 300ppmv followed by an apparently swift increase in the last 56 years. This was presented as abnormal and evidence that human activities were the main cause. Without reduction or mitigation the IPCC concludes that excessive and dangerous global warming will result from increasing CO2.

The present day level of CO2 is 0.04% (400ppmv) of total atmospheric gases. This is little above the minimum CO2 concentration known from geological history. The increase of CO2 from 200 to 270ppmv that occurred between 15,000 and 10,000 years ago enabled successful development of agriculture. Plant growth is generally unsustainable without CO2. Most animals depend on CO2 for survival, either directly or indirectly, and 400ppmv is well below the approximately 1,600ppmv optimum for plant growth. The percentage of atmospheric CO2 attributable to human burning of fossil fuels is about 5%. For comparison, respiration of humans, other animals and phytoplankton is about 25%. Much higher CO2 concentrations than today characterize the geological record, up to 7,000ppmv and possibly more than 10,000ppmv.

Antarctic ice core measurements from EPICA Dome C (Charlie) span almost 800 thousand years with CO2 ranging between 180ppmv and 300ppmv during a sequence of glacialics and interglacialics. Individual ice core samples were taken at regular intervals of 0.55 metres that represent periods of 100 years to more than 1,000 years owing to ice compression and do not represent equal periods of time. The temporal resolution is therefore too low to reveal short term fluctuations like that of the last 56 years. Ice core studies have shown that a rise in temperature is followed by an increase in CO2 after a lag of between 200 and 1,000 years. This is because CO2 is less soluble in warm water than cold water. Erroneous reversal of cause and effect is used by the IPCC to blame warming on increasing CO2. Ocean temperature controls atmospheric CO2 levels. Lag times can exceed 5,000 years between onset of heating and the rise of CO2. This adds complexity to interpretation of shorter term variation when heating is rapid as at the end of an ice age, and similarly with rapid cooling at the beginning.

For over 17 years (October 1996 to July 2014) there has been no statistical change (i.e. the trend was horizontal) in mean global temperature as determined from Remote Sensing Systems lower troposphere satellite data. However, CO2 has continued to rise during this period.

4. Ocean temperature data to a depth of 2,000 metres using Argo floats since 2000 were presented to show a temperature rise. Adjustments made to original data were not mentioned. Data are generally absent from the Arctic Ocean and the Southern Ocean.

Since 2000, free floating Argo floats in ice-free parts of the ocean have measured vertical mean ocean temperature anomalies between 2000 metres depth and the surface. Floats added by 2003 brought the overall total count to about 3600. Adjusted data (2003 to 2013) from the U.S. National Oceanographic Data Center show slight mean warming trends per decade of 0.067 degrees C (Indian Ocean) and 0.061 degrees C (South Atlantic Ocean). Lower and inconsequential mean warming trends per decade of 0.007 degrees C (North Atlantic) and 0.009 degrees C (Pacific) are clearly in contrast. Raw unadjusted data actually show even lower warming rates or slight cooling. Temperature data are very sparse for depths below 2,000 metres and show a decline since 1992. Extensive submarine volcanism and other factors were not addressed and are mainly ignored. Much remains to be investigated.

The debate is not over

My view is that climate science is not settled and the debate not over. Empirical data regarding variations in solar activity, regular changes in Earth’s orbit, and ocean circulation and temperatures strongly suggest these are the main climate drivers. CO2 is beneficial and not detrimental to life. It does not drive climate and I suggest the effect of humans is minor. For the last 50 million years Earth has shown an overall cooling trend, with included shorter warming trends. We live in the latest warm interglacial of a 2.59 million year-long ice age that has had multiple alternating very cold glacial episodes and warmer interglacial periods. Scientific evidence points to a continuing temperature decline towards the next glacial, with warm and cool fluctuations on the way. I suggest that by the mid-2020s, if not sooner, the next cool period will become apparent and by 2055±11 will have become established as a mini ice age likely to persist for tens of years at least. Preparations are not being made, though conditions for life in temperate zones may become brutal. Future costly energy and food policies are linked to political decisions that I consider are unsupported by scientific evidence and will damage our economies.
Elements of Earth is just one of 14 themes that are explored in the exhibition, *The Elements: From Actinium to Zirconium*, open at least into early 2016 in the Ulster Museum, Belfast. About 90 elements, from hydrogen up to uranium, occur naturally on Earth but most of them are pretty scarce. The air in our atmosphere is dominated by just two - 78% of it being nitrogen and 21% oxygen – which leaves only about 1% for everything else including the carbon dioxide (less than 0.4%) that is the focus of so much attention these days. In fact the most common gas in our atmosphere after oxygen is the inert gas argon. Most of this argon is not part of Earth’s original atmosphere but forms from the decay of radioactive potassium-40, which is found in small quantities in many rocks such as granites, into argon-40. For the same reason the atmosphere of Mars contains around 2% argon. All of the other gases in our atmosphere amount to less than a tenth of 1%.

The water and ice that covers 71% of the Earth’s surface similarly are composed of just two elements, hydrogen and oxygen and although many other elements and compounds are dissolved in Earth’s lakes, rivers and oceans, most are at very low concentrations. Even in seawater the sodium chloride amounts to just 3.5%.

The rocks of which Earth is made are far more diverse. More than 3000 different minerals have been described from across the globe and many examples can be seen in the Elements exhibition and, especially, in the Earth’s Treasures gallery nearby. However, the range of different elements found in most of these minerals is surprisingly small. There may be 90 natural elements, yet 90% of the Earth is actually composed of just four of them – iron, oxygen, silicon and magnesium. Of these, most of the iron is in the Earth’s core and much of the magnesium, combined with silicon and oxygen, also lies deep beneath our feet in Earth’s mantle. Just two elements, oxygen and silicon, make up more than 80% of Earth’s crust. Although these rocks are solid, the most abundant element in nearly all of them is oxygen that, in its uncombined state, is actually a gas. Most common mineral of all in Earth’s crust is the simplest combination of these two elements – silicon dioxide, or quartz, the stuff of which most sand grains are made. Many other minerals contain these two elements as a primary constituent and are called silicates, with about 30% of all the minerals so far described being silicates. Oxygen also combines with other elements to forms many of the major chemical compounds, and rock-forming groups of minerals, such as oxides, carbonates, silicates, sulphates, phosphates and nitrates. But, despite this huge range of minerals, 90% of Earth’s crust is made from silicates and, if we look a little more closely, we find that almost 99% of the material within Earth’s crust comprises just 8 elements – the oxygen, silicon and aluminium already mentioned plus hydrogen, calcium, magnesium, iron and sodium. Barely 1.5% is left to account for the other 80 or so elements so even some of those that we think of as quite common are really rather rare. Sulfur might seem abundant, and it is a major ingredient of metal sulfides that are so important as ore minerals, but sulfur actually is pretty scarce on Earth. It is
only 17th most abundant element at an average concentration of just 270 parts per million, or 0.027%. In terms of average crustal abundances there are plenty of other elements that are vanishingly rare. So how do we ever find them? It is geological processes, often involving heat and/or water, which concentrate many of the really rare elements and their compounds into veins or other ore bodies and produce many of the more than 3000 described minerals. However, for some elements this seems rarely, if ever, to happen. Compounds of lead, zinc and copper are common ore minerals but scandium is found in high concentrations in just a few very rare minerals while indium, a metal vital for touch-screens, has no known ores and is produced as a by-product of zinc or tin smelting.

Some well-known rare elements, such as gold and platinum, have a strong affinity for iron. This means that when Earth was molten, soon after it formed, Earth’s original reserves of these metals long ago descended to the core. What we find of them in Earth’s crust today was actually delivered here by meteorites after Earth’s core had formed and its early crust had solidified. Indeed, one of the clues to giant meteorite impacts in the past, such as that at the end of the Cretaceous Period, is a slight increase in the abundance of these platinum-group metals.

Mineral specimens are not confined to the Earth theme of the Elements exhibition but crop up in various others. Copper, tin and iron ores make an inevitable appearance in Elements of Progress, dealing with the stone, bronze and iron ages, while ores of elements such as chromium, tungsten, nickel and caesium make an appearance in Elements of Technology. Two uranium minerals feature in Elements of Fission, along with a slab of Mourne granite which produces the radioactive gas radon, while various coloured varieties of fluorite, quartz, beryl and garnet enrich the already multi-coloured displays of glass and ceramics in Elements of Colour. Perhaps strangest of all, several minerals used in cosmetics can be found in Elements of Death. Sulfides of lead and antimony were used as dark eyeliner, red compounds of mercury and lead were used to redden the cheeks, and white lead carbonate was used in Georgian times to whiten the faces of the aristocracy – sometimes with fatal results. Perhaps my favourite specimen, in amongst the ceramics of Elements of Colour, is a chunk of feldspar containing crystals of the rare-earth mineral gadolinite. It came from the quarry at Ytterby, in Sweden, a site from which at least seven new elements – including
yttrium, ytterbium, terbium and erbium - were described in the 18th and 19th centuries! But, far from exploiting these rare earth elements, the quarry was actually after the feldspar for making porcelain and these minerals were an unwanted contaminant.

The Elements exhibition is not just about the static objects. An ongoing series of free public events is being held in conjunction with the exhibition. Details can be found on the Ulster Museum website at http://www.nmni.com/um/What-s-on/Current-Exhibitions/Elements—From-Actinium-to-Zirconium, from which a flyer of the events can also be downloaded.

The Northern Ireland Regional Group of The Geological Society

Mike Young gives details

The Geological Society of London has recently (see ESI Issue 16, p28) started a Regional Group for Northern Ireland, the latest of 15 regional groups that serve the membership across the United Kingdom. The Geological Society, founded in 1807, is the oldest geological society in the world and has nearly 11,000 members, or Fellows, around the world, about 200 of whom are based in Ireland. The broad objectives of the Society remain much as they have since 1807: to improve our knowledge and understanding of geology and the other earth sciences; to promote public awareness of and education in the science; and to serve the membership through professional support and education.

The Society is actively seeking new members. Benefits include library and information services, a journal and Geoscientist subscriptions, conferences, access to the professional development programme and a route to Chartership. Candidate Fellows (undergraduates) and Junior Candidate Fellows (16-18) enjoy very inexpensive membership fees. Perhaps the most important benefit is that of participating in the largest and most influential geological organisation in UK independent of government, academia or commerce.

The Society is a prominent publisher of leading geological journals and books, notably the Journal of the Geological Society, the Quarterly Journal of Engineering Geology and Hydrogeology and the Special Publications book series. The Publishing House also produces several journals with or on behalf of other societies. All these publications, and other historical journals, are available digitally through the Society’s on-line Lyell Collection.

In addition to its publications, the Society stages numerous conferences, public lectures and events every year, in London and throughout the UK. The attractive monthly house magazine Geoscientist publishes articles of topical interest, correspondence and news.

The London headquarters provides conference facilities, an information service and houses the famous library, one of the finest Earth Science libraries in the world with over 300,000 volumes and 40,000 maps, extending over three floors. The Society is one of five learned societies that with the Royal Academy share Burlington House on Piccadilly, an ornate and imposing Palladian palace.
The Society supports secondary education in geology by publishing a range of educational material and guidance for field courses and through a variety of initiatives for schools, including an annual three day course in teaching geology, supported by BP. The Society publishes detailed information about university level courses and inspects and accredits degree courses in UK and abroad. Although the Society does not provide financial assistance for undergraduate or Masters’ degrees it does support aspects of research and travel at the PhD level.

For Fellows, the Society runs a programme of Continuous Professional Development (CPD) and offers the Chartered Geologist professional qualification. The CGeol ranks with the Professional Geologist (PGeo) qualification of the Institute of Geologists of Ireland (IGI), with which the Geological Society has a reciprocal agreement. Other professional qualifications available to Fellows are European Geologist and Chartered Scientist.

Communications and liaison with the membership is maintained through the regional groups and 22 specialist groups that cover a very wide range of interests and specialities. These report through various Council sub-committees of the Council dealing with science, external relations, publications, education and professional affairs.

A prominent role of the Society that has developed in recent years is in providing an independent and authoritative voice on matters of national interest and concern. Major policy papers have been published on issues such as Carbon Capture and Storage (CCS), climate change, radioactive waste disposal, shale gas and creationism. These are prepared by Society staff and Fellows, in consultation with national experts. The Society also responds to requests for consultations from the House of Commons and House of Lords on these and other matters. In 2013, the Society published a major statement, ‘Geology for Society’, which spells out how and why our science influences so many aspects of our economy and environment.

Geologists in Ireland have been involved with the Society since its inception. Sir Richard Griffith, who compiled the first geological map of Ireland, was among the first to join, in 1808. Joseph Portlock, author of the first Irish geological memoir, was President in 1852-54. More recently, Harry Wilson, a former Director of GSNI, was a Vice-President. Today, those from Ireland who serve include the current Chief Editor of the Journal of the Geological Society and several members of editorial advisory boards, sub-committees and the Council. Among those who have received awards from the Society for their distinguished service are our editor, Tony Bazley (the R H Worth Prize, 2009) and Paula Reimer of Queen’s University (the Lyell Medal, 2012).

The Northern Ireland Regional Group was formed to fill a remaining gap in the Society’s UK coverage of Regional Groups. The Group will work particularly to support its members, most of whom who work professionally in the universities, in the mining sector, in engineering consultancy and in GSNI. We are anxious not to compete with other geological societies but hope to complement and support them where possible. The Group’s policy role in Northern Ireland is already channelled through the Learned Societies Forum, which comprises representatives from various professional societies and provides advice to the All-Party Assembly Group on Science and Technology. The APAG brings together Members of the Northern Ireland Assembly and others with an interest in science, technology, engineering and mathematics (STEM) in Northern Ireland with the aim of raising awareness among MLAs of important developments in STEM, both technological and educational, and how policy issues impact upon these areas.

Everyone in the earth sciences community across Ireland will be most welcome at all the Group’s events, whether Fellows of the Society or not.

For further details about membership and the work of the Geological Society see www.geolsoc.org.uk.

For more about the Northern Ireland Regional Group, its activities and events see www.geolsoc.org.uk/nirg or send an email to GeolSocNI@gmail.com.

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(Editor – the recent election of Dr Jenny McKinley (Queen’s University, Belfast) to the Council of the Geological Society of London, where she joins Mike Young, is welcome and we add our congratulations to many she will have received)
Roscommon’s Geological Heritage (Part 2)

by Robert Meehan and Matthew Parkes

This article continues a brief summary of highlights, arising from an audit of County Geological Sites. Part 1 (Issue 14) dealt with the many karstic sites. This, the final, part looks at the rest of the landscape/rock features noting especially that the county has an excellent visitor centre at Arigna that will intrigue the young and old.

Eskers

The most significant force to shape the form of the country as we see it today was the Ice Age which ended just over 10,000 years ago. Large ice sheets covered the country for thousands of years and eroded the rocks beneath. As the ice eventually melted away, the meltwaters reorganised the sediments into iconic landforms like drumlins and eskers, adjacent to large fans and deltas of sand and gravel.

Eskers are long, sinuous ridges of sands and gravels, laid down or deposited by glacial meltwater. The term “esker” is an English rendering of the Gaelic word eiscir which means ridge. They range from a few tens of metres to over a hundred kilometres in unbroken length, and range locally from a few metres to over 50m in height, and from tens of metres to hundreds of metres in width at their base.

Eskers are usually the infillings of ice-walled river channels. Just as rivers on land carry and deposit sediment, meltwater that flows in the openings beneath, above and within a glacier also carries and deposits sediment. Tunnels near the base of retreating glaciers fill with transported sands and gravels, which remain as sandy or gravelly ridges that look like raised, upside-down stream beds after the glacier melts away. The ice that formed the sides and roof of the tunnel has disappeared, leaving behind sand and gravel deposits in ridges with long, winding, sinuous shapes. Depending on the pattern of the glacier’s inner tunnels, eskers can interconnect in a pattern of central ridges and tributaries, just like a branching river system.

The Irish eskers can be divided into two groups: a northwest-southeast oriented system of parallel-trending eskers which occurs in the northern portion of the country; and an east-west oriented system which straddles the Midlands and the main peatland expanses of the country, and is dendritic. County Roscommon lies on the boundary between both sets of eskers and therefore possesses eskers oriented in both of these directions. Examples included as CGS include Castlesampson Esker, a complex, multi-crested esker which is comprised of numerous beads. The esker system comprises ten individual segments, which stretch for a distance of just over six kilometres. Garranlahan Esker is a long, beaded, often high, sinuous esker ridge system that traverses a lateral distance of over 100 kilometres across the west Central Midlands.

The Ballinasloe-Split Hills-Esker System is a long, beaded, often high, sinuous esker ridge system that traverses a lateral distance of just under 70 kilometres across the Central Midlands, including counties other than just Roscommon. The esker system is one of the finest examples of a long, wide tunnel-deposited esker in the country. The ridge also has many associated fan, delta, and sandur (a plain formed of glacial sediments deposited by meltwater outwash at the terminus of a glacier) features associated with it, such as the Cloonburren Fan and at McKeon’s Pit near Shannonbridge.

Some Ice Age features define the landscape character of large areas yet are so large they can almost only be seen when using satellite or air photo images. One example is a very fine discrete field of drumlins near Boyle. These whaleback, elongated ridges of glacial till were left by the ice sheets which covered the county. Even larger ribbed moraines, on a kilometre scale, are present across mid Roscommon, but these need a trained eye to discriminate them from remotely sensed satellite images.
At Errit and Cloonagh Loughs near Loughglinn, delta features are fine examples of the type of ice marginal, deglacial features that often formed at the edge of glacial lakes, as large volumes of meltwater carried sediment loads into temporary lakes, dammed up by ice sheets.

Other County Geological Sites

The Boyle Road Cutting site provides one representative site for Devonian bedrock in Roscommon, when arid desert conditions prevailed, and red sandstones and conglomerates were deposited by rivers on the land surface. The rocks exposed north of Boyle are evidence of a rare volcanic event at this time, as they are volcanic sediments. Devonian rocks, mostly sandstones and gravels laid down by flash floods in a poorly vegetated environment are not well exposed but occur in the Curleys and Slieve Bawn.

The Carboniferous limestones are dominantly well bedded, horizontal layers of a remarkably uniform nature. They were originally deposited in a shallow marine environment when Ireland was largely submerged under a warm tropical sea, and the presence of fossils such as corals reflects this. The uniform nature of these beds both across wide areas and vertically in thickness makes it difficult to map different geological formations, and they are often simply considered as 'shelf' limestones, from an open, shallow sea. Castlemine Quarry, Largan Quarry and Keeloges Quarry all provide good representation of the early Carboniferous Period, when Ireland was covered by warm tropical seas, and corals and other animal life proliferated in the shallow clear waters. The hill at Largan Quarry was overtopped by ice sheets during the Ice Age, since there are thick glacial tills in a road cut up to the top of the hill at the south side of the quarry. In addition, freshly exposed rock surfaces (in the summer of 2012) at the southern end of the quarry show streamlined bedrock forms known as ‘P’ forms, as well as striations and chattermarks.

The Carboniferous Period actually derives its name from the coal deposits formed in the later part of that time across Europe and North America. This geology is represented by two sites near Arigna, one largely untouched since mining ceased, on the Altagowian area and the other presented in a wonderful and safe fashion for visitors to learn and appreciate. The Arigna Mining Experience is a highly recommended place to visit where underground tours are conducted by ex-miners, so an authentic experience is conveyed.

Stratigraphy in geology is punctuated by gaps where no rocks were formed or where active erosion removed rocks to be deposited elsewhere. In Roscommon, as in most of Ireland except in parts of Ulster, there are no rocks deposited and preserved from the Carboniferous coal rocks through 320 million years to the most recent Ice Age deposits. At Lecarrow on the shores of Lough Ree is one of the rare evidences of weathering and erosion during that time. A Tertiary clay deposit is protected in a karstic solution pipe or doline. Other such deposits are recorded around Ireland, and as with this one, they were often exploited for economic use – in this case for the clay pipe industry at Knockcroghery. However, only a flooded pit remains today.

The story of clay pipe making is well presented in Knockcroghery Clay Pipe Centre and it is well worth a stop. Clay pipes were particularly important at wakes, where trays of tobacco filled pipes, Guinness and whiskey would be provided for the mourners. It may seem strange now, but the clay pipe was one of the most important parts of any wake and was considered improper to be without them. A gross or more was usually purchased and this would then be filled with a twist of cheap tobacco, and passed around to all the mourners in the room.

Geological processes continue to modify the landscape today, such as with seasonal flooding of the Shannon and Suck River Callows.

This very brief summary of Roscommon’s geological heritage is derived from the audit report which is accessible from the website of the Geological Survey of Ireland.

Cloonburren Fan

Cloonagh-Errit Loughs Deltas

Largan Quarry

Arigna Mining Experience

River Shannon Callows
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Geological Survey of Ireland
Beggars Bush, Haddington Road
 Ballsbridge, Dublin 4

website: www.gsi.ie
e-mail: gsisales@gsi.ie

Phone: (01) 678 2000
Lo-call: 1890 44 99 00
Fax: (01) 668 1782

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