Journal 2012

The Great Orme Exploration Society

www.goes.org.uk

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Hello Readers,

Welcome to issue no. 1 of the 2012 edition of the Journal of the Great Orme Exploration Society. This year has certainly been an eventful year for the Society, both underground and over ground. In September 2011, a collapse in Ty Gwyn was not only a surprising discovery, but it provided the underground team with many weeks of hard work digging out the blockage allowing access through the main adit again. The innovative research work being carried out in Romans by PhD Student Alan Williams and assisted by Dave Wrennall looks very promising with more talk on that to follow as research findings unfold. The NAMHO Conference this year was held at the National Trust property at Quarry Bank Mill near Wilmslow. This proved to be another interesting and well attended event, with various underground trips offered to Alderley Edge. Over ground, we have attended the Llandudno Extravaganza, and had a three month exhibition at Llandudno Museum, with representation in the Daily Post, and on Tudno FM! The summer walks were very well attended with weekly adverts in the North Wales Weekly News helping to attract non-members. You can read about these events, and more, in this issue of our Journal, and perhaps feel inspired to join in with current activities either underground or over ground throughout the coming year.

Best Regards,

Debbie Wareham - Journal Editor 2012

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GOES meets informally every Thursday evening in the Kings Head, Llandudno from 9.30pm. All are welcome.

The Great Orme Exploration Society (GOES) was formed in 1985 and became a Company Limited by Guarantee and not having a share capital on 7th April 1999. It is a member of the National Association of Mining History Organisation (NAMHO), British Caving Association (BCA), and works in association with the Gwynedd Archaeological Trust (GAT), the Early Mines Research Group (EMRG) and the Gwynedd bat Group (GBG). Views and opinions expressed are those of the author(s) and not necessarily those of the Society.

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GOES News and Events

News: GOES Members Receive the Queen's Jubilee Medal

2012 was the year of the Queen's Diamond Jubilee. Celebrations were held all around the country and the Great Orme was host to one of the Jubilee Beacons. Quite a crowd gathered on the summit of the Orme on 4th June 2012 to see the lighting of the Beacon. From early evening, the Town Band played while people waited for the sun to set. Eventually, the beacon was lit, and everyone gave a cheer. At the same time other beacons could be seen along the North Wales coast at Penmaenmawr and further north towards Rhyl.

Lighting the Jubilee Beacon on the Great Orme, Llandudno, June 2012

Further recognition of the sixtieth anniversary of the accession to the throne of Queen Elizabeth II was given by the creation in 2011 of the Queen Elizabeth II Diamond Jubilee Commemorative Medal. In the United Kingdom, and its overseas territories, 450,000 medals were awarded to all members of HM Armed Forces, operational members of HM Prison Services, and emergency services personnel (including Police Community Support Officers) who have been in paid service, retained or in a voluntary capacity, and who had completed five full calendar years of service on 6 February 2012. North Wales Cave Rescue Organisation is recognised as an emergency service and three current members of the Great Orme Exploration Society were award the medal: Gareth Davies; Glyn Davies and Stephen Lea, together with former GOES member Erik Sellors.

News and Event: The Great Orme Brammock Rod Reconstruction Project

For many years, Tom Parry has campaigned to have the remaining Brammock Rod pits on the Great Orme acknowledged for their importance to the Llandudno Victorian Copper mining Industry. In autumn 2012, a small amount of funding was made available from the Great Orme Country Park Community Engagement Scheme to the Great Orme Exploration Society in order to develop one of the former Brammock Rod pits and provide some information boards about the former structures.

The reconstruction project is progressing well, and a small A-Frame structure has been designed based on what is thought to be the original Brammock Rod system. The pits have been excavated and stone work tidied up inside. Text has been supplied to develop information boards. Anyone wishing to help out with the project in 2013 should contact Steve Lea. Dates and Times to assist with the project are sent out to everyone via email. Everyone is welcome to get involved. There will be more news of this project during the year.

Steve and Brian taking a break from pit reconstruction work

Ty Gwyn Collapse 2011

On 31st August 2011, a party of walking friends from Penrhyn Bay had arranged via Dave Broomhead to meet at the Ty Gwyn for an evening visit to the mine. I, Steve Lea, had agreed to lead the tour with Brian Edwards assisting. We met as usual on the Llandudno promenade by the pier entrance with numbers slowly growing. This was going to be a large party for the two of us! Just after 7pm with all those present now ready to do underground, we set off into the Ty Gwyn Mine with me leading and Brian at the back of the group.

The Ty Gwyn tour always begins following the main adit then as people become more adjusted to the environment we investigate the smaller side passages. As soon as we had passed from the first ginged (stone lined) section and onto the next section which supports the parallel inclines, I could not believe my eyes. The internal shaft had completely collapsed blocking the tunnel. So as not to invoke alarm in our guests, I made light of the situation by saying, “Oh it appears to be blocked this way, that’s unusual, we will have to go the other way!” After calling Brian to lead the trip around the other way, we set off again. Not wishing to scare any visitors we kept quiet about this major change in the mine. When the opportunity arose later, we checked the other side of the collapse before leaving in disbelief.

The following Sunday 4th September 2011 a full trip was undertaken to investigate the collapse. On closer inspection, the Ty Gwyn adit had been filled to the roof from the entrance side of the adit, and there was no sign of any of the supporting steelwork that had been in place in that section. Gareth Davies took the lead in digging away at the top of the spoil which was now blocking the adit, and very shortly he had exposed a large hole going up into an open vertical shaft. With enough material cleared away, Gareth crawled into the shaft where it became apparent that this once filled shaft had completely emptied its contents into the adit.

At the top of the newly exposed shaft (shown below) we could see a concrete capping which looked as though part of it had broken away. Richie Fletcher looking around the area of the collapse soon found a piece of tarmac lying on top of the spoil. We thought this tarmac had quite likely fallen from the underside of the capping.

After deliberation and reference to our survey plans of the mine, we concluded that the opening to the shaft, or at least part of it was under the corner of Ty Gwyn Road, near the Empire Hotel car park. We agreed to report the incident to the County Council Highway and Infrastructure Service on the Monday morning.

The Council's first action after a site meeting with Mostyn Estates was to secure the area immediately by erecting barriers on the road at the site of the mine shaft entrance. This action inevitably stopped access to the rear of the hotels below Hill Terrace. The Council asked if we could provide a more accurate location of the shaft, so Ali and I took some check dimensions directly to the newly exposed shaft. Unfortunately, we could not provide the definitive answer the Council needed as to the exact location of the shaft as our reference point was to Ordnance Survey plans which were not considered accurate

enough for the Council's needs. The concern was that should the shaft actually be located in the road, then loadings from vehicles could cause a major incident, hence the exact location of the shaft opening was imperative. The Council engaged a firm of land surveyors to survey the area. NRG Engineering Services Ltd of Llanfairfechan contacted me for access to Ty Gwyn on the 9th September 2011 to conduct a formal survey and determine the exact location of the shaft. They used satellite surveying equipment to locate the manhole entrance with two reference points which was then optically transferred down the manhole to two surveying points approximately 500 mm apart fixed into the concrete floor. This method transferred a line of sight directly to the shaft. Their conclusion of the survey was that the centre of the shaft is located under the end of the wall between Hill Terrace and the lower unmade hotel access road. This point is now marked with a yellow surveying disc fixed to the wall.

The Council began an excavation of the area to locate the capping that we had seen from our initial observations. However, their excavations did not manage to locate the capping, which must be at a depth beyond their excavation. The new surface holes were filled in and the tarmac made good. I contacted the Council again to ask if further action was to be taken and was told that additional locating works were proposed by "Dowsing". We left the situation for a number of weeks until it became apparent that no further work was going to be undertaken. It now seemed reasonable for GOES to start to look at the excavation of the collapsed spoil in order to reinstate access through the adit for us and for visitors.

Many weeks of hard work were ahead of GOES underground members to reinstate the access through the main adit. The collapsed shaft is located between two short side passages the first one adjacent the shaft, the other a short walk further into the system. It was agreed that these could be filled with the spoil from the collapse without loss of any future required area.

On the 11th December 2011 the first excavation trip was undertaken with a number of £2 flexi buckets purchased from Asda providing an easy way of moving excavated spoil into the first passage, then tipped and packed into the tunnel. The first day ended with the words “we’re half way through now” which was a little optimistic considering the tonnes of material in front of us.

GOES diggers with buckets to hand ready to remove the spoil

There have been several return visits to clear the spoil. Small dedicated teams of underground GOES members have worked to either dig, carry, or pack the spoil. The first side passage is now full, and this has been finished off with a bow fronted dry stone wall constructed by Dave Wrennell with a display area at chest height to contain some

artefacts recovered during the work. The filled area is approximately 8.9 m² by an average depth of approximately 1.5m. The total approximate amount of excavated spoil moved is 13.4m³ or 20 tonnes. We then started digging from the other side of the collapse, which involved a longer carrying distance. We could see the steelwork from this side. After a couple of digs we removed several sections of girder and channel sections together with some of the reinforcing bars used in the original excavation. Amazingly, these are bent at 40° downwards to the entrance end of the shaft. We have also discovered two large sections of cast iron, one with a connection plate with four bolt holes and several smaller pieces. The force needed to move this amount of reinforcing steel work is quite phenomenal.

So why did the shaft collapse? Further to the investigation undertaken so far it would seem that the shaft collapsed by the floor of the main Ty Gwyn adit beneath the filled in shaft suddenly giving way underneath. This is evident by the bending of the reinforcement bars. The point of the floor collapsing is at the location of the bisecting incline tunnel from above. The incline tunnel runs into the main Ty Gwyn adit at an angle of approximately 33 degrees from above, and cuts across the main Ty Gwyn tramming adit then carries on underneath the adit floor and away below. We currently do not know how far the incline runs further underground for. It is likely that when the Ty Gwyn adit was originally dug the incline was blocked off, probably with timber with supports, then filled in with rock. After years of water running down the tramming adit, the timber would have slowly rotted away. A sudden movement has caused the now unstable floor to collapse under the loading of the filled in shaft from above.

Brian Edward's Diggers Diary:

1/12/2011 Ali Davies, Ange, Sion Jones, Steve Lea, Dave Flowers and Brian Edwards started to clear the blockage below the collapsed shaft in the Ty Gwyn. A good team spirit ensured that the work progressed at a pace and by early afternoon getting on for half (or am I being too optimistic!) had been removed into the side passage. It was a tired and very muddy crew who emerged, still in good spirits, from the manhole later. A drink in the King's Head later rounded off a very satisfying day

18/12/2011 Steve, Dave Wr. Debbie and Ali continued clearing the blockage in the Ty Gwyn. It seems my estimate of the previous week's progress was a touch optimistic! Even so, good progress was made although there is plenty more to do. What better way to burn off calories in the New Year!

08/01/2012 We were digging in the Ty Gwyn once again. Our team comprising of Steve, Ange and Brian moved a fair amount of spoil, but we found that as we progressed forward the extra distance we had to carry the spoil made it hard work for just three people. Hence our call for a minimum four person team.

29/01/2012 The team at the Ty Gwyn consisted of Steve, Sion, Paul Gray and Brian. Progress continues and it is now possible to see the continuing roof of the adit on the other side of the blockage. Still quite a bit of work to do but we are getting there.

05/02/2012 Steve, Dave Wrennall, Ange and Brian attacking the blockage in the Ty Gwyn once again, significant progress was achieved once more. Initially our efforts were directed at removing spoil from the far side of the blockage to the second side passage, Dave, meanwhile, constructed a fine stone wall across our first dump tunnel entrance, which, incidentally is now almost filled. Some of the old steel-work has been recovered and it is now possible to cross the blockage easily. It was four weary souls that wended their way to the King's Head later!

18/03/2012 Steve, Sion and Brian carried on with the Ty Gwyn dig. Progress although slow is significant. At the moment we are working on the far side of the blockage and carrying to next cross cut for disposal. Quite a fair amount of the old steel work has now been unearthed. One find of significance is a solid iron casting five foot long, five inches wide by two inches thick swelling at one end into what resembles a joint. It could be part of a spoke for something really substantial and could only have come from the mine

01/04/2012 Steve, Dave Wrennall and Brian continued the Ty Gwyn dig. Great progress was made with a reasonable route through now possible. More of the old support steel was salvaged including another piece of the solid cast iron casting which is obviously part of that found the time before. Speculation is that it is part of a spoke or possibly a connecting rod - definitely of mine origin.

Author Steve Lea (GOES)

Ange, Erik, Dave and Steve investigating the collapsed shaft in Ty Gwyn

Events in Romans

Bronze Age Detective

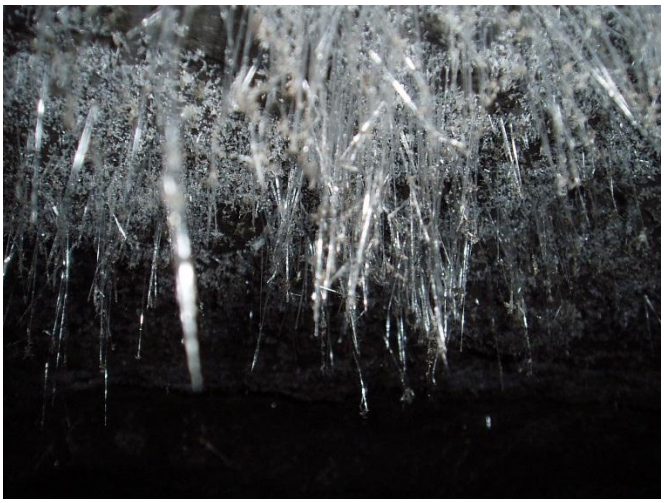
On the 11th of March 2012, Dave Wrennall guided GOES member Alan Williams around Romans to collect rock specimens. Alan, chief geologist with Pilkington (NSG), the international glass company was particularly interested in sites worked in the Bronze Age. As Alan explains**:**

'I have recently started a part-time PhD at Liverpool University trying to match the numerous Bronze Age metal analyses to the very limited data on Great Orme ores. Currently there is a problem matching up these two data sets and so despite being one of the biggest Bronze Age mines yet discovered in Europe, the evidence that it was the source of a significant proportion of the Bronze Age metal is lacking. I hope to re-evaluate this with detailed chemical analyses (using atomic absorption, X-ray fluorescence, scanning electron microscopy) of Great Orme ores from as many sites as possible to establish variation, trace element and isotope signatures from the various mine workings and also the Pentrwyn metallurgical remains, which I am working on with Gwynedd Archaeological Trust and Dave Chapman'.

Whilst down Romans we visited Locations 2, 16 and 5. Copper carbonate hydroxides in the form of the green malachite $Cu_2(CO_3)(OH)_2$ or the rarer blue azurite $Cu_3(CO_3)_2(OH)_2$ were good indicators of copper bearing ores and provided a focus for our collecting. The latter is less common because it is preferentially formed in neutral to slightly alkaline pH conditions, whereas the former is stable over a wider pH range. Both are minerals that occur in the 'supergene zone' i.e. areas of enrichments or secondary mineralisation, formed during the oxidation of copper bearing minerals.

Alan Collecting Ore Samples

Location 16 was of special interest. Here the delicate, white, acicular (long and pointed) deposits festooning much of the roof are strikingly spectacular. '*Probably aragonite; $CaCO_3$ (Chemically the same as calcite but with an orthorhombic crystal form and greater hardness of 3.5 to 4, as opposed to calcite with trigonal crystal form and hardness of 3. But possibly selenite; hydrated calcium sulphate $CaSO_4.2H_2O$ a variety of gypsum. Without closer inspection and/or chemical analysis it could be either mineral' (A Lewis).*



Aragonite

However it was a more subtle pink/purple colouration on a nearby wall that was the real star. Erythrite; hydrated cobalt arsenate, $Co_3(AsO_4)_2.8H_2O$ is an uncommon supergene mineral formed during the weathering of primary cobalt and arsenic bearing sulphide assemblages. Some miners knew it as 'cobalt bloom', a very conspicuous mineral even when present in minuscule quantities, due to its distinctive colour.

The presence of erythrite, as 10-20 µm diameter spheres in copper-ore from the Roman Shaft was recorded by Jenkins & Johnson in 1993. The occurrence is very minor.

Erythrite

Our tour concluded by entering Duncan James' upper Gallery B via the tight crawl from the lower Gallery A. Although this is particularly taxing I thought it would put the upper and lower galleries in better context. Alan coped amiably. After some more ore collecting we eventually escaped through the Time Tunnel. A quick introduction to jumaring and the hauling of heavy bags completed a memorable outing. Having perused, contemplated, chiselled and chipped far longer than normal, all the others visiting the system (Gaz, Richie, Steve, Ange, Debbie and Sion) had long gone, even the pub had emptied.

Best of luck to Alan with his PhD!

Recent blockages in Romans

During our visit in 2012, it was noted that two areas previously opened up by digging were once again block by fresh falls. The extension to Location 2, beyond the 'T'-junction; here the 'scary window' has shut, blocking new dig as well. (cf 2011 Journal). Anniversary Chamber and 'Icing on the Cake' passage in Location 15, above the 8m shaft; here the unstable looking wall on the left, was! (cf 2010 Journal). No doubt efforts will be made in the future to re-open these areas.

Author Dave Wrennall (GOES)

My first year on the Great Orme as a member of the Great Orme Exploration Society by Lieutenant Colonel (Retired) Nick Challinor (late Royal Army Physical Training Corps)

Life is a funny old thing, just when you are in your prime (55) you are retired from 40 years service in the Army, and put out to grass. Luckily that grass turned out to be on the Great Orme with the Kashmir Goats.

I am a firm believer that all things happen for a reason; I met Tom Parry in the first couple of days of moving into our (Lorna and I) house on the Great Orme and he informed me about life in Maes y Facrell and some of the Pen y Gogarth mysteries. He also told me that a goat round-up was imminent - so stupidly ignoring the old military maxim of 'Never Volunteer', I got in touch with Sally (the warden of the Orme) and joined the other members of the round-up team. I did not realise I had been set-up for 4 days of Commando survival training - thanks Tom. As a glutton for punishment I was then persuaded to become a Conwy Warden Volunteer, it turned out to be a great move. It meant I would travel to most of the North Wales Coast Country Parks and be involved in general Country Park maintenance - litter picking/gorse and bramble cutting/path clearing/sign mending etc, but the great spin-off was that I would be working with people who were dedicated to looking after the local environment and destined to see places I would not normally visit.

Apart from restoring the house, playing golf and the occasional shopping trips to Chester, there was still something missing, I needed something else! I had previously been involved in Adventurous Training during my time in the Services - Canoeing/climbing/skiing and caving etc, so I needed something to fill that gap and the GOES was just the thing. By the time I joined GOES I had already done several hundred miles of walking on the Orme and had started to see strange things that needed explaining; so GOES was perfect in helping me find out more about this fantastic lump of Limestone.

It all started with a series of summer evening walks; a very varied and interesting programme, a programme that must be kept going. I sampled the mysteries of St Tudno's Cemetery and Church (big thanks to the Church wardens), the Wall walk, the preserved forest tree stumps of the Conwy estuary, to name only a few. It was just what I needed - I was starting to get a real feeling of empathy with the mighty worm. What lay next was a trip underground; I had enjoyed caving in the past, but I must admit it was never at the top of my list, but Ty Gwyn mine was great; Steve, Brian and the team made my first underground trip with GOES, one to remember. Several escapades later I was starting to feel part of the team, but at the same time aware that there were other more dedicated troglodytes in GOES who were going deeper in more difficult mines and actually digging old ones out. That was something for another day - and with better kit and training!

The Thursday evenings in the Kings Head have become a very pleasant routine and it was there that our latest project concerning the Brammock Rod Pits was mentioned by Steve - (be it Tom's idea from 20 years previously!). Here we are today trying to create something worthy of giving a feel for Victorian mining ingenuity.

So a big thank you, to all GOES members for making me feel so welcome and imparting your knowledge, and in some cases wisdom, in this my first year as a GOES member.

Author Nick the Ormite (GOES)

NAMHO Annual Conferences Past and Future

What is NAMHO?

NAMHO is the National Association of Mining History Organisations, and GOES is a constituent member. Amongst its functions NAMHO holds each year a conference, generally including not only talks but also underground trips, to which all are invited.

NAMHO Annual Conference 2011

The 2011 conference was held at Preston Montford field studies centre (near Shrewsbury) from Friday 29 to Sunday 31 July and was hosted by the Shropshire Caving and Mining Club who were celebrating their 50th anniversary that year. Surface visits to nearby sites of interest were arranged, and there was also a large selection of underground trips available running over the weekend and into the middle of the following week. The location of these included various Shropshire metalliferous mines, Cambrian slate quarry and Ironbridge tar tunnel. Only one GOES member attended the conference.

NAMHO Annual Conference 2012

This year's conference was originally planned to be at Nenthead but had to be moved elsewhere at short notice. It is to the credit of the Derbyshire Caving Club that they succeeded in finding a suitable location (easily accessible by both car and public transport and with meeting rooms, catering, bars and on-site camping) and ably organised the programme of lectures and site visits. The venue selected for the introductory reception and slide show, talks, sales stands and the Saturday evening conference dinner was the National Trust property at Quarry Bank Mill near Wilmslow,

Cheshire. Here participants could, in the breaks between formal conference activities, admire the steam and water powered machinery of the eighteenth century cotton mill, and stroll in the gardens, woods and fields. The "cave" in the estate grounds turned out to be rather a disappointment though! A range of accommodation was available locally for those who preferred not to camp.

The main theme of the conference was the mining heritage of Cheshire and the neighbouring counties of Derbyshire and Staffordshire where copper, lead, coal, fireclay, salt and fluorite have all been mined. Some of the lectures focussed on historical aspects of mining, while others described modern efforts to re-establish recreational access to old mines, and there was even a glimpse into the future with mention of current plans to open a new potash mine in North Yorkshire.

Most of the field trips were to nearby Alderley Edge whose copper and cobalt mines are familiar territory to Derbyshire Caving Club members. Although the rock at Alderley Edge is predominantly sandstone and on the Orme is limestone there is a link in that both were significant sites of Bronze Age copper mining, the subject of a conference talk by Simon Timberlake. Surface and underground visits to the Edge were available in profusion and ranged from gentle walks with the geologist Chris Carlon to sporting trips involving SRT and boats. Further afield there were tours of disused collieries and metalliferous mines as well as a rare underground visit to the still operational Winsford salt mine.

In 2012 four GOES members attended the conference talks and between them went on a wide selection of surface and underground trips. Can we do even better next year?

Ange, Steve, and Alan at NAMHO 2012

NAMHO Annual Conference 2013

The 2013 NAMHO conference moves to Wales and will be held at the University of Aberystwyth from 28 June to 1 July. It is being organised centrally by NAMHO with the support of the RCAHMW's[1] Metal Links project. Accommodation will be available in student rooms as well as elsewhere in the town, and there will also be a camping option for the hardy and/or impecunious. It is intended that there will be a lecture programme on the theme of *Legacies of historic mineral extraction* as well as field visits to relevant mining sites in Ceredigion. NAMHO constituent groups, particularly those based in Wales, are invited to provide information on their activities in the form of either a talk or a poster. Perhaps GOES could at least provide a poster display of activities on the Orme.

More details of the 2013 conference can be found at:

http://www.namhoconference.org.uk/

[1] RCAHMW is the Royal Commission on the Ancient and Historical Monuments of Wales.

Author Ange Gawthrop (GOES)

GOES Exhibition at Llandudno Museum

From March until early June 2012, GOES had an exhibition at Llandudno Museum. We took over the temporary exhibition space for a weekend to put the exhibition up, and transformed the area into an exciting and engaging exhibition covering 26 years of GOES activities.

Assembling the GOES Exhibition: Gaz, Brian, Richie, Steve, Angie

Thematically, the exhibition generally covered the main aims of GOES – Exploration, Research, and Conservation. We filled two display cases – one with various GOES artefacts, and the other with the research of former Liverpool University PhD Student Jo Jones' work on Badgers Cave. Gaz Davies became a *Museum feature* for three months, as we chose him to be our subject to illustrate an aspect of our exhibition called Profile of a GOES member. Gaz brought in a variety of items to have on display, ranging from his personal collection of memorabilia on Llandudno, to items about mining. We even managed to arrange a slot for him to appear on Tudno FM – quite a star!

Dave Flowers brought along a variety of superb minerals to have on display – some of which for a short while found their way into the main museum display on Llandudno's

Copper Mining Industry.

The main display walls of our exhibition included photos and information about Ty Gwyn, Old Mine and New Mine plus off Orme Activities. But what's really important about GOES and a point we wanted to highlight in our exhibition is the people who over the years have contributed to GOES being the Society that it is. To capture that aspect of GOES we had a GOES memory wall where over the three months that the exhibition was in the museum, members could bring in a photo, and put it on the wall adding a comment to say why that photo was important to them.

GOES Exhibition at Llandudno Museum, March – June 2012

We can all cherish past times, but it is important to be progressively minded and contemporary. Embracing this concept within our exhibition, our key idea was to integrate social media into our museum displays and have a few QR codes in place to allow anyone with a smart phone who was in the museum to contact us and leave a message or ask a question. The link to the GOES website enabled more information to

be accessed about the Society in an instant for any keenly interested museum goer. This was a huge success.

A Selection of GOES Artefacts in a Llandudno Museum Display Case

Profile of a GOES Member: Gaz's Display Case at Llandudno Museum

To illustrate the fact that GOES operates on the Great Orme as well as beneath it, we arranged a super walk about Copper Mining which broadly followed the route around Parc Wall. This was a joint effort between GOES and the Friends of Llandudno Museum, with Debbie Wareham as Chair of the Museum Friends group at that time. The walk and talk was written and led by Steve Lea, and was superb!

Steve Lea explaining Brammock Rods to Brian (GOES) and Bob (Museum Friends)

All said the 2012 GOES exhibition was hugely successful with many positive comments being given. It was hard work, but well worth it and could only have happened with the fantastic team that made it happen, as always with GOES! Thanks to all who contributed to the displays, the walk, and visited the exhibition.

Author Debbie Wareham (GOES)

GOES Exhibition at the Llandudno Victorian Extravaganza

Our annual visit to the Llandudno Victorian Extravaganza in May 2012 was as successful as ever. This year we had a display tent for two days rather than one and it proved to be a great idea. Additions to the display boards this year with the interim results of the re-survey of Llandudno's First Pier remains brought an extra interest to our traditional displays about Ty Gwyn, and the other Llandudno Mines.

People were aghast at seeing into the entrance of Ty Gwyn, and having a few artefacts on display as handling items was certainly fun for children. For the partially sighted visitors staying at the Belmont Hotel who visited the GOES Tent, the handling objects gave an opportunity for people to engage with some of what GOES discovers underground, and the type of equipment we use.

Steve emerging from Ty Gwyn Mine entrance with amazed onlookers

An artefact of particular interest on display this year was the George Brookes Medicine Bottle, found in the spoil of the recent Ty Gwyn Collapse. George Brookes (1789) and his wife Anne (1794) lived at the Victoria Inn, Llandudno - the site of the Great Orme Tram Station. They had eleven children – seven sons and four daughters. George Brookes was the Mine Agent for the Ty Gwyn Mine, and in 1841 five of their seven sons

were Copper Miners. One of George's sons, Edward (1822) had a son George Edward (1848) who married and had a number of children one of whom was a son called George (1871) who became a pharmaceuticalist who lived and worked at The Medical Hall, 101 Mostyn Street Llandudno.

Bottle found in Spoil of Ty Gwyn Collapse - George Brookes (1871) Medical Hall Llandudno

Debbie Wareham (GOES) is Great Great Great Grand daughter of George Brookes (1789) Victoria Inn, and it is fascinating that the Medicine Bottle of George Brookes (1871) is now being used to illustrate the heritage of Llandudno's Victorian Copper Mines in 2012, with Brookes' family members still associated with the Ty Gwyn Mine.

This year at the extravaganza in support of the recent resurvey of the remains of Llandudno's old pier, Steve and Debbie led a walk under the current pier to show locals and visitors some of the remains of the old pier. The event was very successful.

We look forward to the Extravaganza in May 2013, and hope for fine weather again.

Author Debbie Wareham (GOES)

Resurvey of Llandudno's First Pier

In early April 2012, Steve Lea, Abigail Lea, and Debbie Wareham carried out the first stage of a resurvey of Llandudno's first pier. The tide caught them out a little, so the next stage of the survey to complete the work has to be rescheduled. Needless to say enough data was recorded to produce an interesting 3D graphic of how the pier looked, and would have been constructed.

Taking measurements of Llandudno's First Pier

Background to Llandudno's First Pier:

During the nineteenth century the main economy of the township of Llandudno was copper mining. Most men were employed in the three main mining areas of the Great Orme and Llandudno, namely Old Mine, New Mine and Ty Gwyn. Since 1836 there had been several plans to develop Llandudno Bay into a harbour, to serve the flow of traffic from Ireland, and as an export port for collieries in Denbighshire. In 1853, Parliament had passed plans for *The St George's Railway and Harbour Company* to develop Orme Bay as a port, with a railway line running straight to the coast. A condition of these plans was the construction of a pier. Llandudno's first pier was opened in 1858.

However, the St George's Railway and Harbour Company did not win the economic monopoly to develop the railway line from Holyhead. Their competitor, *The Chester and Holyhead Railway Company,* won the contract, with Stephenson's unique plan to cross the Menai Straits being the winning factor.

All that was left of the St George's harbour plan was the three miles of railway line from Llandudno Junction to Llandudno. With a reduction in the demand for copper, by the middle of the nineteenth century, Llandudno needed to develop a new economy. This was the start of Llandudno as a tourist resort.

On Wednesday 26th October, 1859, a great storm raged across the North Wales coast causing much destruction. It was the same storm that wrecked the *Royal Charter*, with a loss of four hundred and fifty nine souls. Another casualty was Llandudno's first pier, which was badly damaged during the storm. It was repaired but remained an eyesore. Despite this, it was functional for several years, when it was eventually demolished. The remains were sold at auction in 1878 to build a bridge over the river Conwy connecting Llanrwst, and Trefriw.

The interim results from the old pier resurvey were used in the 2012 Friends of Llandudno Museum Summer Exhibition on Maritime Llandudno. Debbie Wareham was

the curator for this exhibition. GOES organised a walk in early August 2012 to look for remains of the old pier as a joint venture with the Friends of the Museum. The walk was attended by 25 people. We will write a full report about the pier and the re-survey when complete.

GOES walk searching for Llandudno's Old Pier, 2nd August, 2012

Author Debbie Wareham (GOES)

GOES Summer Walks 2012 Review

In 2012 GOES completed 14 Thursday evening walks. Four of those were away from the Great Orme, and each walk has been supported by a team of contributors – members and non-members. A wide range of subject areas have been covered – Old Pier, Parc Wall, Geology of Bishops Quarry, Prehistoric Tree Stumps and we have visited Conwy Morfa, Llandudno North Shore, the Great Orme and elsewhere. GOES welcomes members and non-members to the summer walks programme. We look forward to another varied programme in 2013. Thanks to Brian and everyone else who contributed in 2012.

GOES Searching for Pre-historic Tree Stumps on Conwy Morfa, 2012

Author Debbie Wareham (GOES)

A Selection of GOES Summer Walks 2012 Photos

Picture Montage Steve Lea (GOES)

Musings on the Geology of the Bishop's Quarry on the Great Orme, Llandudno

The Bishop's Quarry is located close to the Summit Complex of the Great Orme. From the complex, the main quarry is the crescent shaped outcrop approximately 150 metres to the south, around which for years locals and visitors have used small limestone blocks to mark their names, initials or comments on the grass. Although this is the most obvious part of the quarry, the comments and observations in this article mainly concern the long approximately NE-SW trending section exposed behind the main quarry, access to which is by the path around the eastern corner. The rocks exposed in this section are easier to access and provide more opportunity to observe the geology in safety.

Martin with GOES Members visiting Bishops Quarry, May 2012

The rocks of the Great Orme were formed during the Visean Epoch of the Carboniferous Period, approximately 330 million years (Ma) ago and are part of what is collectively known as the Carboniferous Limestone sequence. It should be noted that at this time Britain was located close to the equator and was part of the recently formed supercontinent, comprising all the earth's major landmasses, which was to become

known as Pangea. If this statement seems hard to grasp it should be remembered that the earth's crust is in constant motion and that even now India is moving north into Asia causing the Himalayas to rise, and the northern Atlantic Ocean is widening by ±25mm per year. This is similar to the rate at which a typical person's fingernails grow. Such is the expanse of geological time that it would only have required an average movement of 2.1mm per year for Britain to have drifted from the equator northward to its present position over a period of 330Ma.

Limestones, such as those of the Orme, are in essence sedimentary deposits of calcium carbonate ($CaCO_3$). They are usually deposited in marine environments but they can also be of freshwater origin. Extremely varied in type and appearance, they may be almost completely devoid of any fossil material and comprise calcium carbonate that has been deposited directly from the $CaCO_3$ dissolved in the water or may be almost 100% composed of fossil material such as the chalk of southern England. Although the latter, characterised by its pure white colour, shows little obvious internal structure it consists almost entirely of the remains of microfossils (such as foraminifera and coccolithophores) that are largely not visible to the human eye.

The limestones of the Bishop's Quarry are representative of those towards the top, and hence youngest, of the sequence of rocks exposed on the Great Orme and form part of the North Wales Gronant Group which overlie rocks of the older Dyserth Limestone Group. The fact that younger sedimentary rocks usually overlie older rocks was originally formulated by the Dane, Neils Stensen (Nicolas Steno), in the mid 1600's. It may seem obvious now, but geologically the concept is very important as it led to the supposition that in an undisturbed sedimentary sequence, fossils at the base are older than those at the top. Hence they could be used to establish the relative ages and relationship of different rocks or correlate deposits over large areas.

Generally the limestones of Bishop's Quarry are mid to dark grey in colour but appear paler grey on the weathered surfaces. Although the succession is predominately

limestones, there are occasional thin interbedded bands of mudstone and calcareous sandstone. In parts the limestone is massive and thickly bedded with little obvious structure however in other parts it is thinner bedded and highly fossiliferous. The section as a whole dips gently in a northerly direction (340º to 020º) at an angle of 10º to 16º forming the southern limb of the gentle saucer like depression (syncline) of the rocks present on the Great Orme.

These rocks were laid down by the Carboniferous seas that advanced over the pre-existing landscape which consisted of older Silurian and Ordovician rocks that had been buckled and raised up during the Variscan (Hercynian) mountain building episode. This occurred during the late Devonian and early Carboniferous and was caused by the closure of the ancient Rheic Ocean as the world landmasses began to come together to form the unified supercontinent of Pangea. Locally the sea advanced over the raised landmass of the approximately west to east trending Wales – Brabant Massif which separated the North Wales area from South Wales. As it advanced it progressively covered more of the North Wales area creating a shelf over which the rocks of the area were deposited. This inundation of the landmass was mainly due to subsidence of the land rather than a rise in sea level, although to all intents and purposes the result on a local scale is the same.

The variation in thickness of bedding and nature of the deposits seen in the Bishop's Quarry reflect a combination of factors. The more massive limestone beds were laid down on the shallow shelf when there was very little material being transported into the area from the land of the Wales – Brabant Massif to the south. Deposition was constant over long periods of time with little interruption or disturbance. Indications of less stable conditions are where the limestone is more arenaceous (sandy) and sections with argillaceous (fine grained) mudstone or shale bands. These represent times when there has been an influx of material transported from the land over a period of years, seasonally or exceptionally one episode such as a storm. Some of the thicker

sandstone or mudstone bands may indicate times when there was a short-lived change in the relative sea level.

General view of part of Bishop's Quarry showing fallen slabs with *Productus* colonies

Martin explaining banding features found in Bishops Quarry to GOES members

Major indicators of the conditions that existed during the formation of the beds of the Bishop's Quarry are the fossils that are preserved in them:

Productus – Fossils of the Order Productida belong to the phylum Brachiopoda which has existed from the Cambrian Period to Recent, although the species *Gigantoproductus giganteus*, which is present in the quarry, dates from 328 – 345 Ma. During this period productids exhibited various changes in their form, especially their size. *Gigantoproductus giganteus* is the largest of all the brachiopods and in Bishop's Quarry specimens up to 22cm in width can be found, and elsewhere they have been found with widths of over 30cm. Productids are generally semicircular in outline and consist of two shells (valves) which are symmetrical about their midline but with each individual shell being of unequal size. The larger valve is concave with spines while the smaller valve is convex.

Its overall weight and the spines on the large valve, which are rarely preserved in fossils, helped to anchor the whole animal to the sediment on which it lay. It was sessile (immobile), spending its life in one location, and existed by filtering food from material suspended in the passing water. Its habitat was shallow water or areas close to coral reefs.

The massive fallen slabs of limestone covered in productids that can be seen towards the south-western end of the quarry show them crowded together in a mass on the sea floor as they would have been in life. The fact that they are known to lie with their large convex side down can be used to identify whether a rock is in its original position or if it has been overturned by folding, faulting or tectonic movements. The orientation of a bed or series of rocks is extremely important for a geologist to know. Within the quarry productids can be seen stacked one on top of another, where on death the upper, smaller shell, has been detached and washed away allowing a second productid to settle in the remaining depression. Examples can also be found where the empty shell of a productid has been infilled with detritus and broken shell material before being covered by more limestone. These can also be used as indications as to whether a bed is in its original position or whether it has been tilted or overturned.

Crinoids – The common names for these fossils are 'Sea Lilies', which gives a false impression as they are animals, or 'Feather Stars'. The Class Crinoidea to which they both belong represents the most primitive members of the Phylum Echinodermata which includes sea urchins and starfish. They are found from the late Cambrian to Recent, although all of the older fossils including the Carboniferous examples are 'Sea Lilies' which have stalks, while most modern examples are free swimming 'Feather Stars'.

The 'Sea Lily' crinoids of the Carboniferous are attached to the sea floor by a stalk or stem with 'rootlets' at the base. The body is located in a cup or calyx at the top of the stem, from which five arms radiate. The stem is formed of a series of separate plates or ossicles which are round, five sided, or star shaped in cross section. The calyx consists

of rows of plates with the arms, which are usually branched and often feather-like, emerging from the top row.

Usually it is only broken parts of the crinoid stalk that are found as fossils as although the calyx is the most robust part, there is only one per animal, whereas the stem tends to break into small pieces or individual ossicles. Such is the case in the Bishop's Quarry where crinoid ossicles can be seen weathered out on the surface of the limestone. In cross-section they are circular (up to 6mm) with a hole in the middle through which the animal's soft parts extended. When seen side on, they are visible as individual ossicles 1 – 2mm thick or small sections of stalk formed of a number of ossicles joined together. The weathered condition of the crinoid remains in this location are such that it is difficult to definitively identify the individual species although what evidence there is, particularly the round cross-section, would indicate that they belong to the genus *Amphoracrinus* which is typically found in Visean age limestones.

Corals – Poorly preserved examples of the fossil coral *Lithostrotion* can be found in Bishop's Quarry. These are colonial corals of the Order Rugosa that became extinct at the end of the Palaeozoic Era about 250Ma ago. The many species of *Lithostrotion* which vary widely in form are common in the Carboniferous Limestones of Britain. Corals deposit tube-like calcareous corallites which in colonial corals combine to form a colony. The individual tubes may either be touching or separated in different species, which influences the shape of the corallites.

The only examples found in Bishop's Quarry consist of cross-sections of the circular corallites, separated from each other by about 2-5mm, on the surface of some blocks. The massive nature of the limestone has meant that little of the structure is visible either on the cross-section or on the vertical section. Any detailed structure has been destroyed by the process of mineralisation. Coral development is indicative of quiet reef conditions; they are fragile, and are not often found far from their living positions.

Bryozoans – These are frequently referred to as 'moss animals'. They are very small colonial animals which are very varied but are often found encrusting the rock surfaces; they can have an almost lace-like appearance.

***Productus* infilled with detrital material, also showing circular crinoid ossicles to left below shell**

Although it is very minor, note should be made of the mineralisation present in the Bishop's Quarry. It is almost exclusively in the form of calcite mineralisation, which occurs along joints or fissures present in the limestone. However, minor quartz veining can be seen at the north-eastern end of the quarry. Most of the calcite exhibits little or no structure but in places calcite crystals can be found. These are white and break into rhombohedra where none of the faces are at right angles to each other. This reflects the internal crystal structure of calcite. Individual crystals of up to 20mm can be found.

There are 'slickensides' on some of the mineralised surfaces present within the quarry. These are lineations, often polished, which can form when there has been movement between two surfaces. The lineations form parallel to the direction of movement and they can also indicate how each surface moved relative to the other. Care has to be taken though as slickensides do not indicate the extent of movement, they can form as a result of only a few millimetres movement or on surfaces associated with major faults.

Calcite crystals from north-east end of Bishop's Quarry

The title of this article was chosen intentionally as 'Musings on the Geology of the Bishops Quarry' to reflect the fact that it was not intended to be detailed academic paper on the geology of the quarry. The intention has been to describe and explain some of the geological features that can be seen in the quarry, in the hope that it may be of interest to non-geologists as well as those who have knowledge of the subject. At a casual glance the limestones of the Orme may look grey and dull. However, there is no boring or dull rock. All rocks are worth looking at and have a story to tell, which is what makes geology so fascinating.

Author Martin Trevelyan-Jones (GOES)

Brian, Martin, Richard, Steve, Bob – On the summit of the Great Orme, May 2012

The Caving Code:

1. Get the basic gear: Helmet, lamp, warm clothing, spare lighting, insurance.
2. Always get permission from the owner: If in doubt, ask the local group; always leave the site secure and follow the 'country code', close the gates.
3. Tell someone where you are going. How many, which mine and where, time in, out and home-contact; if overdue contact **CAVE RESCUE 999**.
4. Never go underground alone or intoxicated: The minimum number is four, one to stay with the casualty and two to go for help. Alcohol or drugs in you, or one of the group, compromises the safety of the entire group.
5. Do not exceed your capability: Do not over estimate your skills and endurance; and remember it is always more difficult coming out against gravity.
6. Do not get lost: Take a reliable plan or guide from the local group.
7. Never climb on mine ladders or machinery: If it is rotten you will not defy gravity for long, but you will accelerate at 32ft/sec/sec.
8. Never climb on stacked or dead walls: They may collapse around you like a house of cards; take care.
9. Never fool around underground. It might be the last thing you do for yourself or your mate(s), or they do for you.
10. Do not spoil the mine environment: Take your rubbish home, leave artefacts in situ, leave bats and other flora/fauna alone. Do not smoke.
11. Know your emergency self-help drills: Don't panic; apply first aid to save life (bleeding, breathing, consciousness) prevent deterioration (shock, hypothermia) and promote recovery (reassurance, and go easy on the gallows humour); stay with the casualty while two of you go for help.
12. Access to the mines on the Great Orme is controlled, but is available to caving groups or individuals via the **Great Orme Exploration Society Ltd**. Arrangements for guided access can be made with the Society Secretary.
13. **TAKE** only photographs, **LEAVE** only footprints, **KILL** only time.