

Tees Valley RIGS Group

QUARTERLY NEWSLETTER

Issue N^o. 1

December 2013



Medieval quarry by the River Tees upstream of the bridge at Egglestone Abbey



www.tvrigs.org.uk

Conserving geodiversity in the districts of

Redcar & Cleveland · Middlesbrough · Stockton · Hartlepool · Darlington

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A Word from the Chair

We have talked a lot about it – and now we've done it.

Welcome to our latest venture – a quarterly (or thereabouts) newsletter.

Andy is editor-in-chief. It would be nice if we could all contribute from time-to-time, even if it is only a few words to prove we are still alive. Format will no doubt be variable but that poses no problems, the important bit is the ethos of communication on a subject we all presumably enjoy.

We are just descending from our “high” of our year-long ***Jurassic Plant Fossils at Marske Quarry*** project which we deem a great success. Methinks we even surprised ourselves at what we achieved – some of which will be with us permanently, e.g. the exhibition materials, the website revamp and recently excavated fossils.

So, where do we expect to be in a years time?

Well we are continuing discussions with Durham University departments about potential student projects in our area (watch this space...). Those who can manage midweek activity are intending to revisit sites and survey work in Darlington. Perhaps a review of the quality and documentation of our RIG sites is needed, and much more besides.

So have a lovely read, and respond in the next issue with comments. Lively debate is to be encouraged.

A pleasant Christmas to all.



Alan Simkins

P.S. What's in a name? Especially one people don't understand. I have this thing about TVRIGS Group as a moniker – and would much prefer something that people can understand - like **Lower Tees Valley Geoconservation Group**. What do you all think? Perhaps an item for our next meeting.

Sites News

The TVRIGS list of geological sites currently holds information on 190 localities some 40 of which are designated as being regionally important. Members of the group continue to explore across our area of operation.

Over the past two years or so we have discovered or confirmed the continued existence of around 20 localities. In addition our year-long project at Marske Quarry has helped rekindle local public interest in geology in general, and the site has also been the source of some fine fossil plant specimens collected by members of TVRIGS and Cleveland Naturalists.

A number of sites around Darlington have been added to our list including Permian Magnesian Limestone exposures alongside the River Tees near High Coniscliffe, disused lime quarries, and a critical exposure of the Carboniferous-Permian junction within Middridge Quarry which yields excellent fossils (see featured article). Several further sites are also being examined around Darlington including fault-disrupted exposures near Elm Grange.

Heavy Autumnal rain helped to create new exposure alongside Millholme Beck (near North Skelton) of rocks close to the Lower-Middle Jurassic junction, a horizon of particular interest to several of our members.



Recent exposure alongside Millholme Beck

On the coast at Red Howles between Redcar and Marske an infrequently exposed outcrop of the Calcareous Shale Member (Redcar Mudstone Formation) has been documented and details added to our list. Similarly a wave-cut platform in glacial till, and normally covered by beach deposits, situated seaward of old Marske High Street. Earlier in the year Redcar's Submerged Forest was well exposed and photographs were taken showing extension to the west of Redcar Beacon.



Redcar Submerged Forest



Wreck and extension of deposits west

Ravines in the Staithes Formation, incised by glacial runoff, have been confirmed above Wilton village on the north side of Eston Hills, and beds of white shale in the Middle Jurassic Scalby Formation (originally mapped by George Barrow) are once again exposed near Kiltonthorpe.

Our explorations will continue.

Quaternary and Holocene Sites List

The TVRIGS sites list holding information on geological sites is somewhat dominated by pre-Quaternary solid rock exposures. The content does not reflect the fact that within the Lower Tees Valley and East Cleveland exposed rock makes up less than ten percent of the district's land surface. Across the greater part of the area underlying country rock is obscured by deposits of till (clay, sand and gravel) from the last (Devensian Stage) glacial episode which ended here between 18,000 and 16,000 years ago.

The invading ice-sheets also sculpted landforms as they advanced, incised (frequently abandoned) melt-water channels as they wasted away and modified the district's systems of drainage.

To redress this imbalance the RIGS Group is compiling a second list of sites containing details of Quaternary and early-to-mid-Holocene landscape features and deposits. It is hoped to have a first version completed in early 2014.

Middridge Quarry, County Durham: A Site of Special Scientific Interest (SSSI)

Middridge quarry (NZ 248 252) lies about half-a-mile SSW of Middridge between Shildon and Newton Aycliffe. The small quarry in the Magnesian Limestone was first notified in 1981 as a SSSI since it is an internationally significant palaeontological locality having the richest and most diverse Permian flora in Britain as well as remarkably well preserved vertebrates. Its conifer-dominated flora compares with the Kupferscheifer flora of Germany and Hungary. The assemblage at Middridge is of great interest for yielding the oldest British ginkgo (probably the oldest member of the *Ginkgoaceae* found anywhere) and probably the oldest British Cycad.

Equally famous are its vertebrate faunas. Middridge has yielded 11 species of fossil fish, reptiles and superbly preserved invertebrates. Three species of fossil reptile have been collected from the vicinity: two species of *Proterosaurus* and a *Lepidosaurus*. Other finds of bone indicate the potential of the site for further higher vertebrate discoveries.

Before 1978, only the Raisby Formation (formerly termed Lower Magnesian Limestone) had been exposed in this quarry, but since then, excavations at the south-eastern end of the quarry have exposed the underlying Marl Slate and Basal Permian Breccia resting unconformably on Upper Carboniferous (Lower Coal Measures) rocks. This provided the first opportunity for nearly 100 years to collect from one of the most fossiliferous localities in Durham.

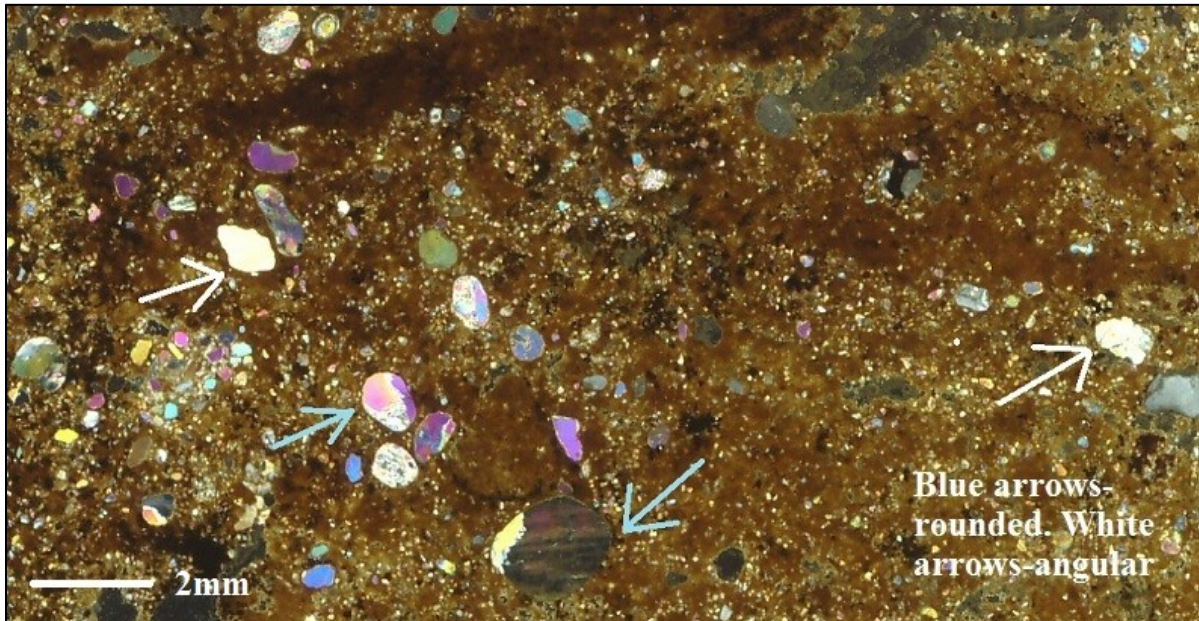
The following sequence is seen at Middridge Quarry

Raisby Formation (Lower Magnesian Limestone)
Marl Slate Formation
Basal Permian Breccia instead of Yellow Sand Formation
Unconformity
Channel sandstone, Upper Carboniferous, Lower Coal Measures

Basal Permian Breccia

After a time of considerable erosion, the climate became arid resulting in a desert environment similar to the present day Sahara Desert. The photograph below shows dunal ridges known as *seif dunes*. Several sites in Durham, e.g. Quarrington Quarry, show spectacular exposures of “fossil” seif dunes. Middridge Quarry, however, seems to have been situated between the dune ridges (see photo below). Here, the Basal Permian Breccia consists of angular and well rounded (millet seed) quartz grains set in a fine grained matrix of magnesian limestone as seen in the thin section photograph below. No doubt the angular grains are from the eroded Lower Coal Measures

sandstone and the rounded grains from seif dunes. The matrix is from the initial Zechstein Sea flooding.



Microscope thin section of Basal Permian Breccia (crossed polars: high interference colours are due to the section not being at the standard 30 micron thickness.)

[Photo: John Waring]

Dunal ridges of the Rhubal Khali, Arabian Peninsula. These ridges are about 1-2km wide and up to 150m high. County Durham would have looked very much like this during the Early Permian.



Marl Slate

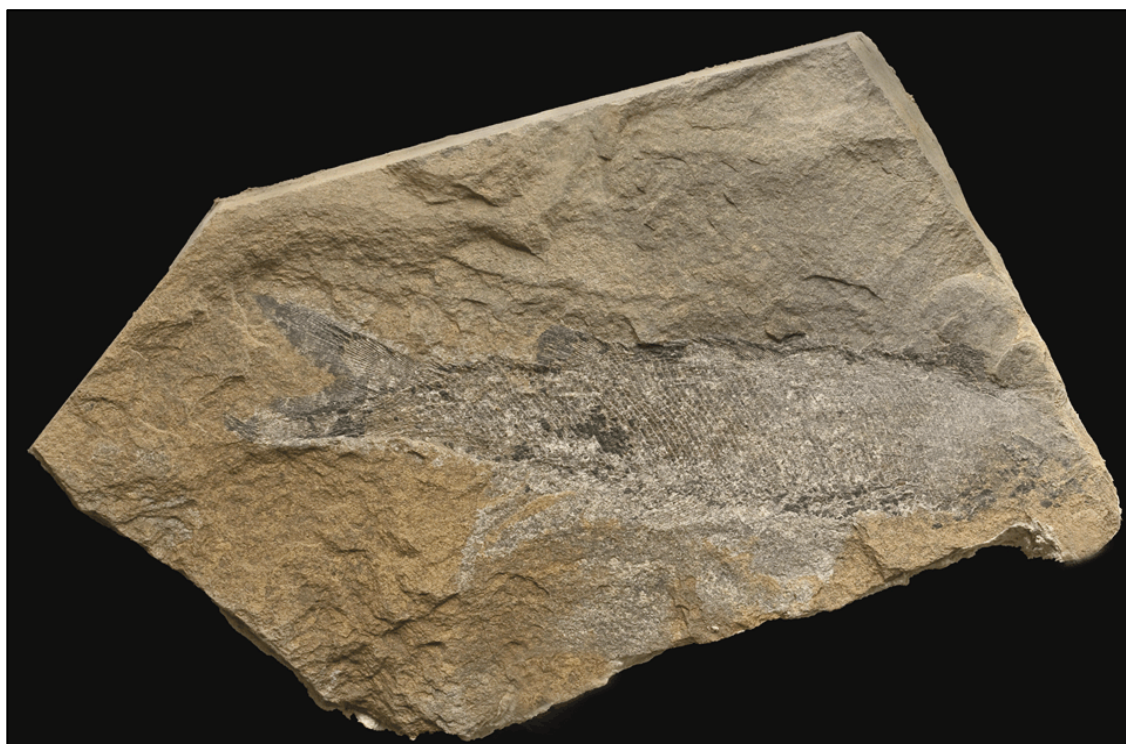
The Marl Slate, in spite of its name, is not a slate in the strict sense, but it is finely laminated, thought to be the result of periodic algal blooms. The layers suggest that it formed over a period of 17,000 years. The formation is famous for its well-preserved fish and other vertebrates. It has been suggested that the large quantities of plankton which were periodically swept into the basin resulted in anoxic conditions at the base of the water column. At death, the macrofauna, including different types of fish, would sink to the bottom where they would have been remarkably well preserved due to the poisonous reducing conditions on the sea bed. This environment protected the organisms from scavengers, decay and disintegration.

Raisby Formation

The Marl Slate is overlain by a thick sequence of magnesian limestones with the Raisby Formation at the base. The sequence is occasionally interbedded with residual evaporite deposits. It is generally accepted that the semi enclosed Zechstein Sea periodically underwent increased salinity leading to the precipitation of halite and other salts such as anhydrite. Millions of years later, with eventual uplift of Permian deposits, some of the enclosed evaporite deposits dissolved, resulting in collapse residues, a classical example of which can be seen in the cliffs at Seaham, County Durham.



The above photograph shows the sequence at Midtridge Quarry (excluding the Raisby Formation) [Photo: John Waring]



Photograph of fossil fish (Palaeoniscus freiselebenensis) from the Marl Slate at Midtridge Quarry [Photo: Paul Forster]

J.W.

Coal: A finite resource, but why?

We all know about the vast Carboniferous coal deposits formed when ancient trees fell into marshy swamps, which then were buried deeply beneath later deposits causing the fallen wood to become transformed into coal.



*This page comes from Book 15 of the 4th edition of Meyer's Konversationslexikon (1885–90) and shows an impression of Carboniferous swamps
[Image: Wikipedia]*

The Carboniferous Period ended around 300 million years ago, and with it so largely did the creation of new coal deposits. Yes there are thin seams of coal recorded within subsequent geological Periods. For example, locally we know about coal workings in the Saltwick and Cloughton Formations of the Middle Jurassic on Danby Moor and elsewhere during the 18th and early-19th centuries where seams are rarely more than 12 inches thick and usually much thinner than that.



Anthracite - a high grade coal from the Carboniferous
[Image: Wikipedia]

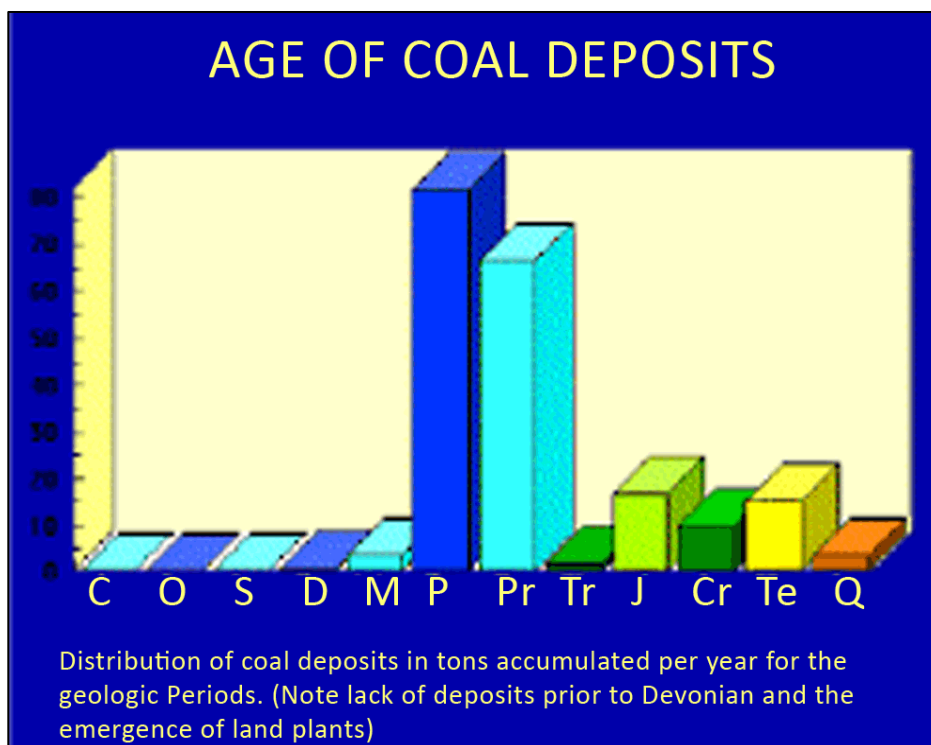
Why, following the end of the Carboniferous Period was there such a significant reduction in coal-forming processes? After all, there is thought to have been a fairly constant forest cover on a world scale and therefore a fairly constant supply of dead plant material.

Researchers at the Lawrence Berkeley National Laboratory in the US have recently suggested that the answer may be due to the emergence, around 300 million years ago, of a type of fungus able to digest *lignin* (the polymer that creates the hard 'woody' substance which forms the outer layer of tree-trunks and branches).



Trametes versicolor
 [Image: Wikipedia]

The relevant 'White Rot' fungi, now common in our woodlands recycling dead wood, have been shown by genome analysis to be descended from that 300 million year old ancestor, and include *Trametes versicolor*, *Xylaria hypoxylon*, *Ganoderma* species and *Armillaria* species (Honey Fungus).



Graph showing deposits of coal by geological Period
 NB: Columns marked M and P equate to the Carboniferous coals.
 [Adapted from image at earthsci.org]

What is the response to this research from the geological community? All is silent to my knowledge - but maybe there are stirrings in the geological undergrowth...

A.S.

Note: More information from Scientific American can be found [via this link](#).

The De Brus Cenotaph, St Nicholas Church, Guisborough

The De Brus Cenotaph, a table tomb, is one of Cleveland's most impressive monuments. Located in the southwest corner of the church it has received a lot of attention in recent years especially owing to the efforts of local Project Groups. It dates from around 1520 and is made up of huge slabs of 'marble', local limestone¹ that is intricately carved and polished up to 4.5 by 1.2 metres in size. One part is missing and an objective is to find this. The late Grace Dixon, the well-known North Yorkshire historian, believed that the stone was local in origin coming from the vicinity of Egglestone Abbey near Barnard Castle.

John Leland, writing in the 1540s, remarked, '*Immediately beneath the cliffs on both banks of the Tees next to Egglestone are outcrops of very fine marble*' and '*About a quarter of a mile below Egglestone, right on the river bank, is a fine quarry of black marble mottled with white*'. This was the source of stone for a number of monuments in the north of England including, for example, the shrine of St William of York that can now be viewed in the Yorkshire Museum.

The medieval quarry (at NZ 0645 1505) can still be seen by the River Tees 100m or so upstream of the road bridge at Egglestone Abbey. Well-spaced joints (natural fractures) and bedding planes make it apparent that blocks up 3 x 2 x 1.5 metres or more in size could be extracted and there is a natural stone barrier left in place to provide some protection against flooding.

The rock is a compact fine-grained, medium grey, bioclastic (crinoidal) limestone from one section of the Great Limestone. There are scattered crinoid columnals mostly 0.5 to 3 mm. in size. It will take a good polish and can be carved in great detail. The Great Limestone is a major unit within the Lower Carboniferous succession, formed around 330 million years ago, whose outcrop extends over much of The Dales, North Yorkshire and western County Durham. It has been worked for ornamental stone at several other

¹ *Geologically marble is a metamorphic rock that has been subject to extreme temperature and/or pressure. The few British examples include those from Skye and Iona in the Hebrides.*

localities such as in Nidderdale, Dentdale and Weardale. Frosterley Marble is perhaps the best known; much has been used in Durham Cathedral and splendid modern sculptures by Keith Murray can be viewed on his website (www.ksmurray.com). It is a dark limestone packed with the fossil solitary coral *Dibunophyllum bipartitum*. Swaledale Fossil Marble, another crinoidal limestone but paler in colour, comes from Barton Quarry near Darlington. It is proposed to use this stone for the Tomb of King Richard III. Other limestone of similar age from elsewhere in the British Isles includes the Kilkenny Marble, a dark, black, crinoidal limestone from the Black Quarry, Kilkenny, Ireland's 'Marble City'.



Figure 1: *The de Brus Cenotaph, 1520.*
Source: *Evening Gazette.*



Figure 2: *The Shrine of St William of York in York Museum.*



*Figure 3: The monument of Sir Ralph Bowes of Streatham, (1494-1516), in Egglestone Abbey. The side stones are 0.34 x 0.7 x 3.3 metres in size. Sir Ralph fought at Flodden in 1513. The top is missing and the limestone badly weathered.
[Photo: D. Goldring]*



*Figure 4: Late 14th C. Egglestone Marble slab commemorating Sir William and Lady Pursey of Barforth Hall at St Mary's Church, Gainford.
[Photo: D. Goldring]*



Figure 5: Egglestone Marble slab on the floor of the North Porch at St Mary's, Gainford showing disarticulated crinoid stems.



Figure 6a: A modern living crinoid. Crinoids are animals related to sea urchins that become sessile in adult life.



Figure 6b: Fossil crinoid showing the complete animal with stem, crown and arms.



Figure 7: The Medieval Quarry site on the south bank of the Tees. Beds (posts) are close to horizontal (the apparent dip is slight downstream, the true dip to the northeast). The main joint sets are aligned N-S and ESE-WNW.
[Photo: D. Goldring]

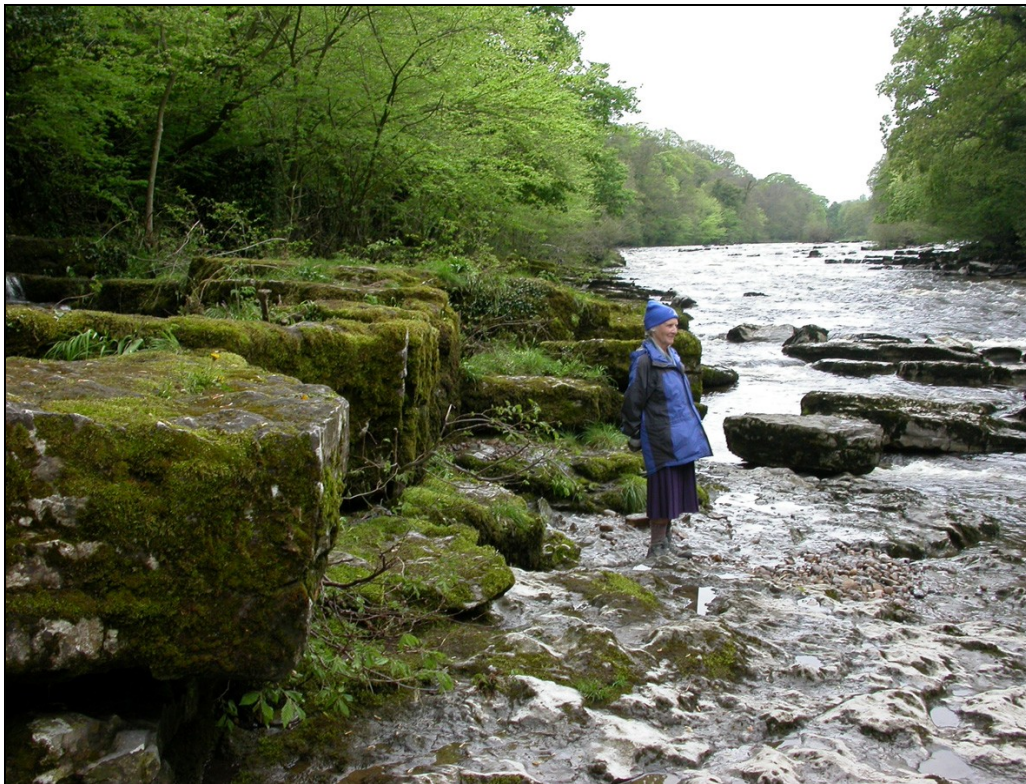


Figure 8: Another view of the quarry site showing the natural wall of stone retained to prevent flooding.
[Photo: D.Goldring]

D.G.

Ice Age Relics: Skelton Buried-Valley & Cat Nab, Saltburn

The Victorian seaside resort of Saltburn-by-the-Sea is well-known for its water-powered cliff lift, cast-iron pier and towering cliffs of Jurassic rock toward Huntcliff. Less well-recognised perhaps are landscape features that date back to the later part (Devensian Stage) of the Quaternary Period, an episode of glaciation which came to an end here between ca.20,000 and 16,000 years ago.

One such relic remained undiscovered until the late-1800s and sinking of mineshafts for Longacres Pit near Skelton. As the shafts were being sunk a level was commenced from a point on the south side of Skelton Beck close to the railway viaduct to assist with drainage of the workings. However, instead of encountering solid rock a short way into the valley side (as expected) the level continued for a worryingly long distance within clay. So concerned were the mine owners that they began prospecting along the level's projected course, sinking boreholes in a bid to locate solid rock. Eventually they found it, but much nearer to the mine than predicted and with clay up to 100-feet thick intervening.

What the miners had driven their level through was part of a river valley dating from before the last ice age more than 100,000 years ago. Several similar features, dubbed buried-valleys, are known of in the district including part of the River Tees which formerly debouched into the sea via Hartlepool Headland.

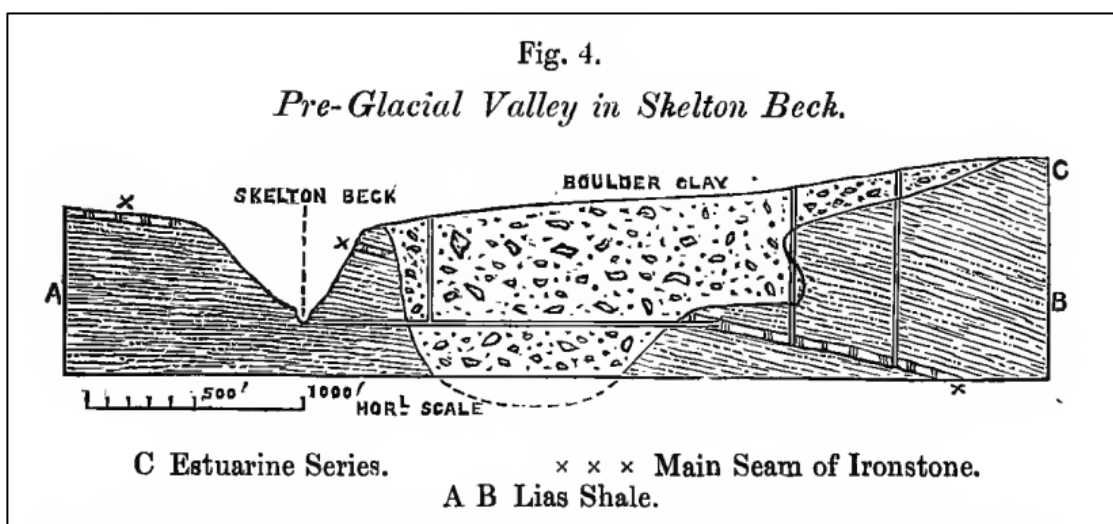
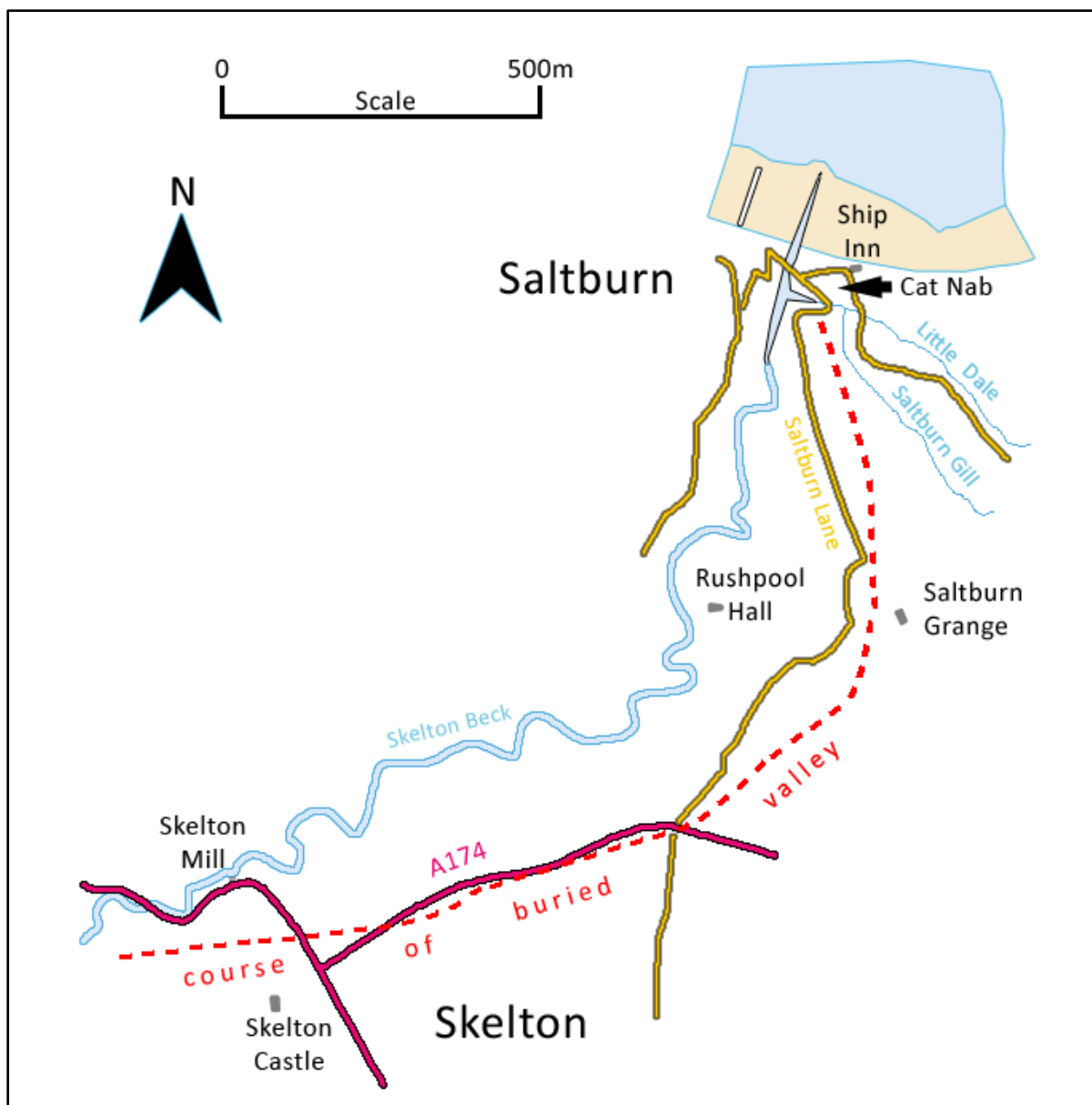


Diagram from page 70 of The Geology of North Cleveland (1888) by George Barrow showing a section across the buried-valley at Skelton including boreholes and water level.

Such valleys, occupied by ice during the last glaciation, can become wholly or partly choked with clay, deposited when the ice-sheets eventually waste away, causing drainage to find alternative routes.

West of Skelton Castle, Skelton Beck today flows along part of this ancient valley where it is cutting down into its clay infill. At Skelton Mill however the stream deviates to the north east where it has eroded a new course deeply into the country rock almost all the way to the sea. The clay-filled former valley continues unseen on the south side of the beck passing east beneath the A174 Skelton by-pass before hooking north between Rushpool Hall and Saltburn Grange (see map). From here the clay infill forms a ridge, between Skelton Beck and Saltburn Gill, along which Saltburn Lane runs.



Simplified map showing course of modern drainage, approximate course of buried-valley and location of Cat Nab

This brings us to a second relic, with close links to that described above, able to be found at the buried-valley's seaward end. Here a steep hill with grassy flanks and a red-coloured eroded summit known as *Cat Nab* rises some 25 metres or so above the foreshore between Saltburn's Ship Inn on the east and Skelton Beck mouth on the west. This feature is an erosional outlier composed completely of clay dissected from the main body of the buried-valley to the south by a westerly diversion of Saltburn Gill to its confluence with Skelton Beck nearby.



View of Cat Nab from Saltburn Beach

Long before ice overlying the Saltburn area disappeared, large volumes of melt-water found a way through and beneath the ice to commence down-cutting of the modern courses of Skelton Beck and Saltburn Gill. Cross-cutting relationships demonstrate that the Gill appears to have originally divided just south of Cat Nab with one branch cutting the nick point between Cat Nab and the Ship Inn. The second branch veered west to a confluence with Skelton Beck near its mouth. When these outlets were partially established a third flow commenced from the high ground east of Saltburn, probably involving a water body held up against Warsett Hill, to initiate Little Dale. This is the northernmost of several fairly steep NW trending tributaries which enter Saltburn Gill from the east. A substantial flow cutting Little Dale could have easily enhanced the westerly course sufficiently to force the Gill's former northern branch to become abandoned leaving a nick point through which the Brotton Road today passes.

Please note: In the first diagram showing early glacial drainage (below) contours for land east of Saltburn about Little Dale are imagined based upon modern contours.

A.C.

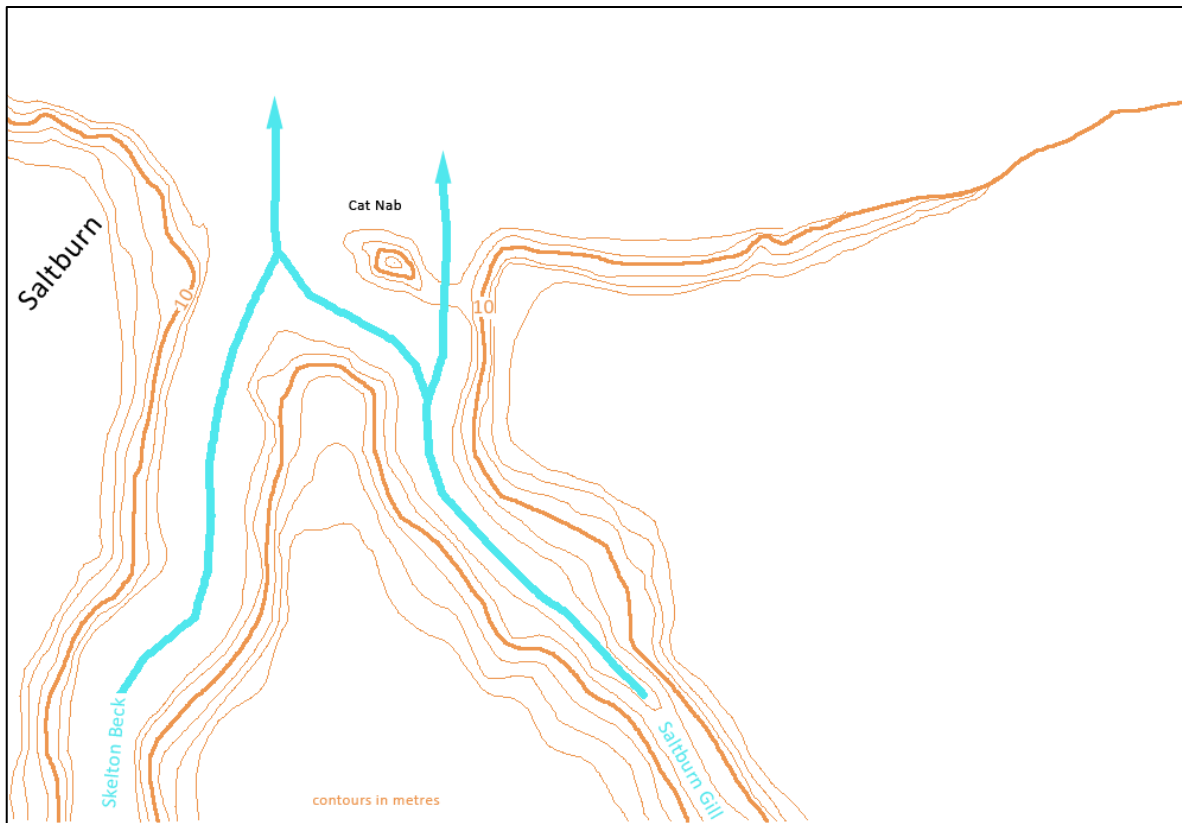


Diagram showing early sub-glacial drainage with divided flow through Saltburn Gill cutting nick-point west of Ship Inn.

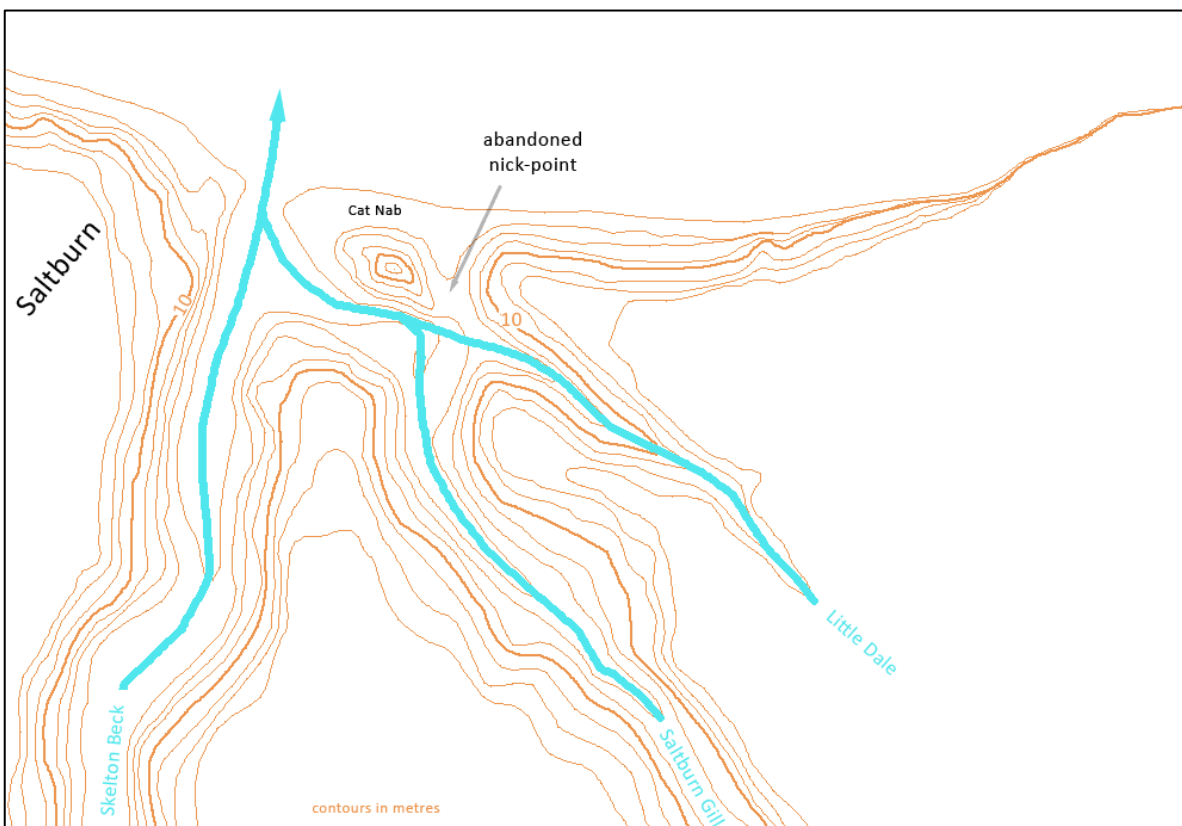


Diagram showing later flow along Little Dale redirecting Saltburn Gill to the west causing abandonment of nick point.

Events Diary

Listed here are various events publicised on other geological sites...

From the website of the [North East Geological Society](#):

January 17th 2014

How we can understand Pyroclastic flows

Dr. Richard J. Brown

Durham University

February 21st 2014

Getting Into Hot Water: Exalting Low-Enthalpy Geothermal Opportunity in the UK

Prof. Jon Gluyas

Durham University

From the website of [Cleveland Industrial Archaeological Society](#):

13th January 2014

Workhorse of Industry

The talk will be based on photographs taken by Norman Skinner in 1962 when he took a tour of the country looking purely at industrial locomotives in their everyday working environment. It will offer the opportunity to see what industrial sites were like when nearly all transport within industry was by 'shunters'.

Richard Barber

St. Mary's Centre, Corporation Road, Middlesbrough

February 10th 2014

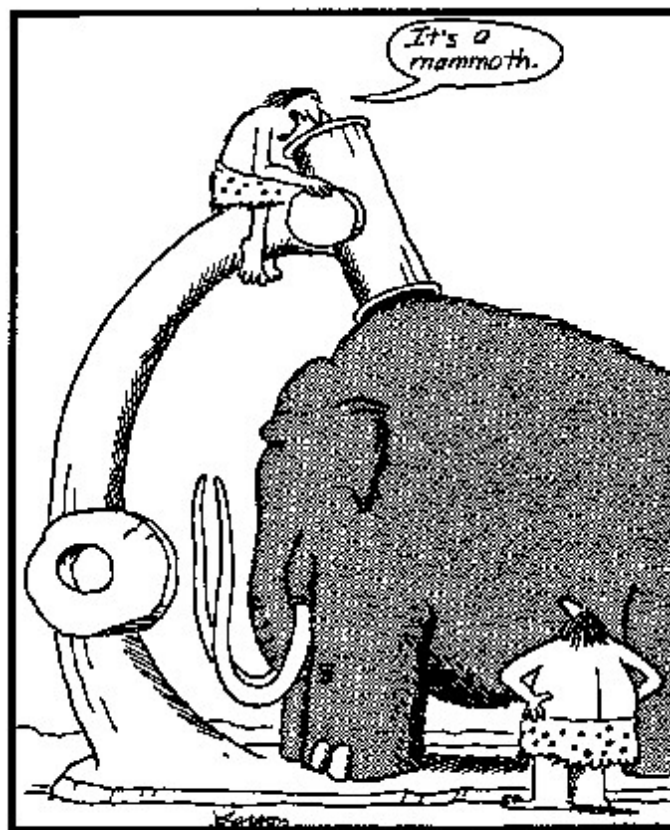
Building with iron and steel

The talk, illustrated by local examples, will examine the different techniques that were used to incorporate cast iron, wrought iron and steel in the construction of buildings and bridges.

Charles H Morris
St. Mary's Centre, Corporation Road , Middlesbrough

PLEASE CHECK THE APPROPRIATE WEBSITE FOR FULL DETAILS

Humour



Early microscope

News from the Web

Given below are links to geologically-themed stories on other websites.

Can the secrets of Roman Concrete lead to reductions in CO₂ production?

The chemical secrets of a concrete Roman breakwater that has spent the last 2,000 years submerged in the Mediterranean Sea have been uncovered...

<http://newscenter.lbl.gov/news-releases/2013/06/04/roman-concrete/>

Coal Ash Linked to Earth's Largest Extinction

<http://www.nrcan.gc.ca/science/story/3595>

Fracking: Untangling fact from fiction

What exactly is 'fracking'? - find out more via these BBC reports.

<http://www.bbc.co.uk/news/science-environment-20595228>

<http://www.bbc.co.uk/news/science-environment-23314874>

Unprecedented Rate and Scale of Ocean Acidification Found in the Arctic

Acidification of the Arctic Ocean is occurring faster than projected according to new findings published in the journal PLOS ONE. The increase in rate is being blamed on rapidly melting sea ice, a process that may have important consequences for health of the Arctic ecosystem.

<http://www.usgs.gov/newsroom/article.asp?ID=3686>

Earth Heritage, a free online magazine, is available from GeoconservationUK at <http://www.earthheritage.org.uk/>

PLEASE NOTE: Tees Valley RIGS Group cannot be held responsible for the content held on external sites.

Editor's Note

I'd like to thank all who have taken the time to contribute to this first issue of our newsletter and look forward to future submissions from the RIGS group membership.

We hope that you have enjoyed the content and that it has got you thinking. Perhaps it's too long, or not long enough. Perhaps it's missing something you feel is important, or includes something you'd rather it didn't. Whatever your opinion we'd value your feedback and will try to act on it.

The next issue is scheduled for March 2014.

Finally (and in a bid to save money on Christmas cards) I'd like to pass on Season's Greetings to all our readers.

A.C.

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