TEES VALLEY RIGS GROUP
NEWSLETTER

ISSUE No. 6
DECEMBER 2015

Cleveland coast looking west from Loftus Quarries

PUBLISHED TWICE ANNUALLY

CONSERVING GEODIVERSITY IN THE DISTRICTS OF

REDCAR & CLEVELAND · MIDDLESBROUGH · STOCKTON · HARTLEPOOL · DARLINGTON

CONTENTS

Winter and spring are arguably the most advantageous seasons for geological fieldwork, when heavily vegetated localities become more accessible, beach deposits can be scoured away revealing coastal features and stream courses may be modified by floods.

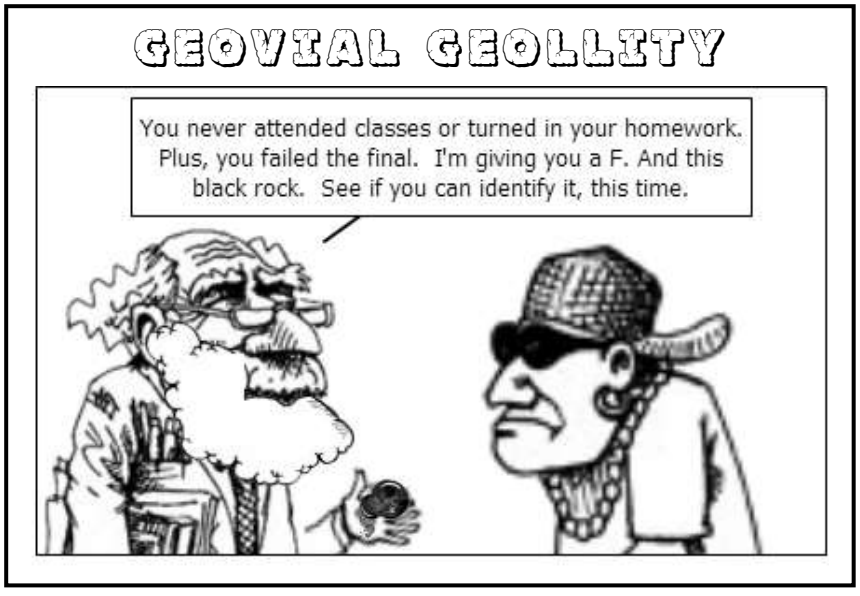
But before you don your thermals and wellies, and dash off up the nearest beck channel to make the group's next great discovery, why not retire to your favourite armchair and put your feet up with Issue 6 of our newsletter.

In this issue we present articles describing our recent work alongside features on Roseberry Topping, a new section entitled *From the Archive*, a modicum of humour and much more.

With the motto of our esteemed chair ("*We must get out more!*") ringing in our ears we can (I'm sure) look forward to another exciting year of geological outings and investigation.

All that remains is for me to thank everyone who works hard to make the RIGS Group a success and wish all of our readers a Merry Christmas and prosperous New Year. I look forward to seeing you all in 2016.

The Editor



News in Brief

New Site at Gerrick

Informal exploratory outings in November along the tributaries of Stubdale Beck at Gerrick Wood, south of Liverton, turned up unrecorded exposures of the Middle Jurassic Osgodby, Scalby and possibly Cornbrash Formations.

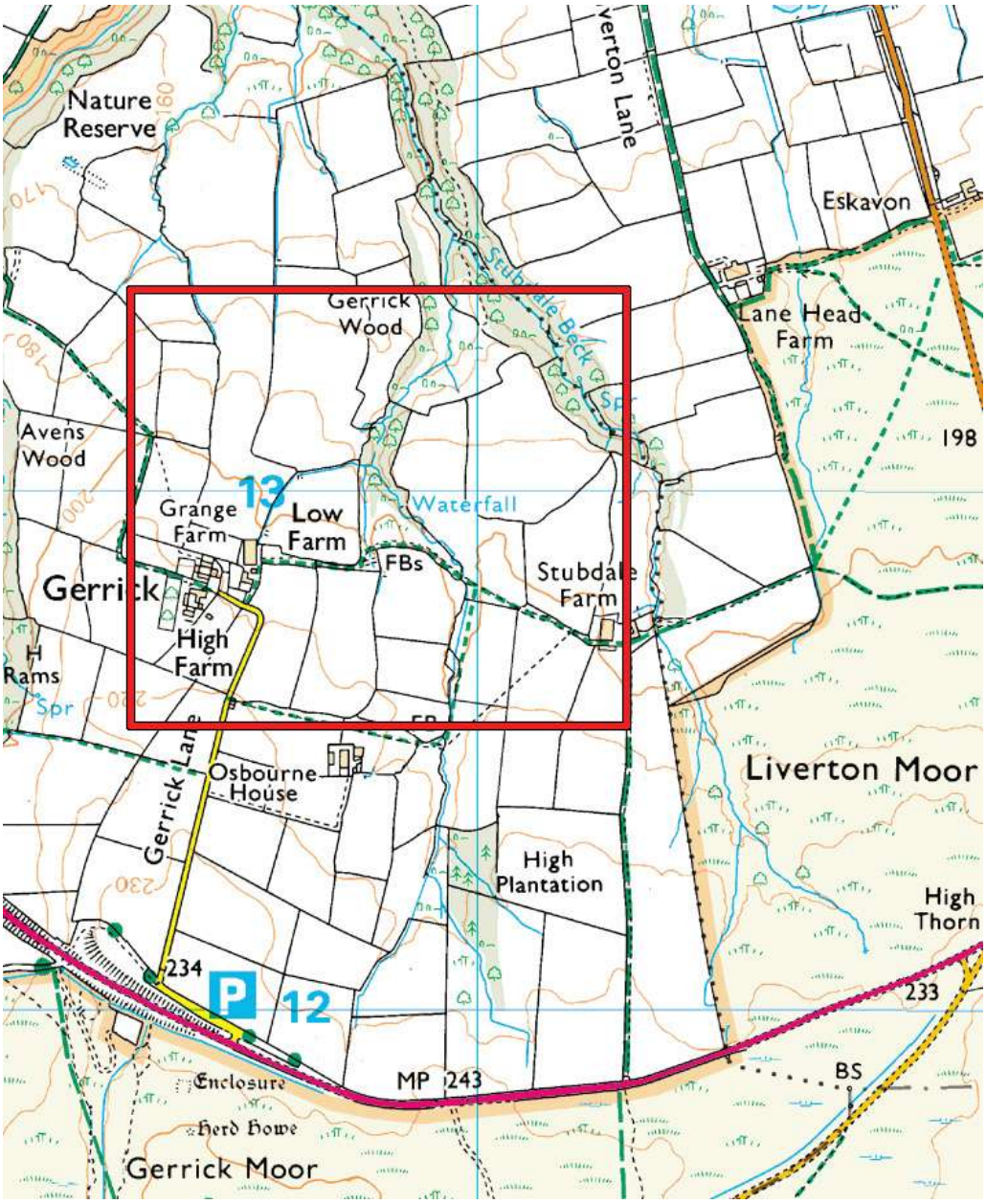


Fig. 1 Excerpt from O.S. map showing general location of exposures near Gerrick (see Fig. 2 for area outlined in red)

Parking near the farms at NZ 7057 1279 two waterfalls occur in the minor valleys to the north east (see Figs. 1 & 2). A footpath runs east to the head of a ravine (labelled 'A'

in Fig. 2) traversal of which is difficult but rewarding revealing exposures of what may be Cornbrash (here a decalcified sandstone) dipping at quite a high angle to the east. The valley is however blocked by fallen trees arresting further progress. Climbing back out of the ravine and continuing downstream higher on its east side for a short distance, a waterfall (labelled 'B') occurs on a second side stream flowing from the east at NZ 7080 1305. After entering the wood from the fields this tributary falls around 3 metres over a heavily vegetated sandstone outcrop within the wood, marked at its base by a bed of ironstone up to 30 centimetres thick. The underlying sandstone (thought to be Scalby Formation) is heavily iron-stained and the ironstone may be the same bed mentioned nearby at Scaling by Barrow (1888, p.59):-

> *"On Easington High Moor is a double line of pits called "Ancient British Settlements". This term has been applied to many similar holes, and in every case they occur immediately above a seam of ironstone, and doubtless are nothing but ancient workings for iron ore."*

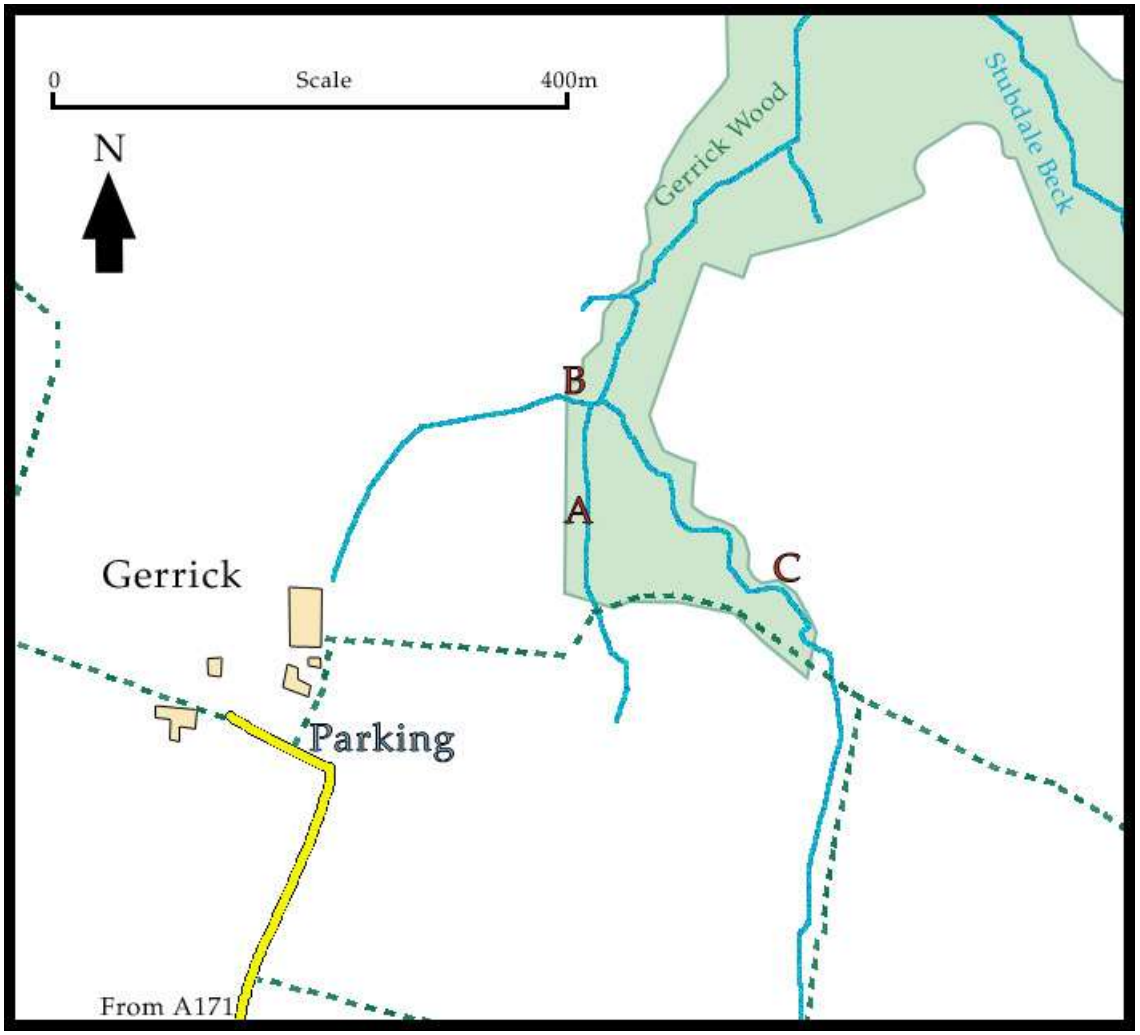


Fig.2 Simplified representation of area outlined in red on O.S. map
A = Outcrop in ravine; B = Waterfall 1; C = Waterfall 2

Three tributaries converge near point 'B' and exploration up the stream which converges from the south east revealed a second waterfall labelled 'C' near NZ 7093 1290. This fall is also around 3 metres high, capped by Osgodby Formation sandstone and underlain by units of sandstone and grey siltstone belonging to the Scalby Formation (see Fig. 3). The Cornbrash is mapped as disappearing close to the first waterfall (B) and missing altogether at the second (C).

Fig.3 Second waterfall near Gerrick at NZ 7093 1290 (labelled 'C')

Winkie's Castle Exhibition

As reported in Issue 5 the TVRIGS *Fossils of Cleveland* exhibition went ahead as planned at Winkie's Castle (Marske-by-the-Sea) between 2nd and 31st July this year. Five display panels, bearing information describing the geological history and fossil legacy of Cleveland, were accompanied by selected specimens from the group's excellent rock, mineral and fossil collection to create an impressive exhibition in this diminutive but important museum's upstairs display area.

Thanks to judicious planning by Alan Simkins and John Waring the event was well-attended by the public, not least on the three occasions that RIGS Group members were in attendance when a smörgåsbord of rock samples and fossil specimens were presented for identification.

As expected samples of Lower Jurassic bivalves, gastropods, belemnites, ammonites, etc. were common, but Carboniferous and Permian specimens also figured. One sample of gneiss containing magnetite, and currently being employed by its owner as a fridge magnet, originated in Africa.

John Waring reveals secrets of the area's geological past to members of the public at the Fossils of Cleveland Exhibition

A partial fossil recovered from the cliff foot at Saltburn, a few hundred metres east of the Ship Inn, was proffered by one visitor that initially caused some puzzlement. Closer

inspection however showed it to (probably) be a specimen of a Pen Shell (*Pinna*) usually found much-flattened on the Redcar Mudstone scars nearby. This example is unusual in retaining some of its former depth from being partly embedded in a concretion. Despite a thin veneer of earthy white calcite, striations on the shell's blackened outer surface and suture lines could be discerned.

Thanks are extended to all who contributed to the project. It increased footfall at Winkie's Castle during the period it was open and delighted many of its visitors. The museum has asked whether the exhibition could be repeated next year for two months, June and July. The RIGS Group will, I am sure, be only too pleased to comply.

Display panels in the upstairs exhibition area at Winkie's Castle

N.B. Jack Anderson, former incumbent of Winkie's Castle, was an inveterate collector of unusual objects; he even left a legacy for geologists to ponder upon.

Whilst in attendance at the exhibition an odd boulder was noticed in the garden to the rear of the cottage by Alan Simkins (see image below), presumably dragged from the beach by Jack, although its true provenance is unknown. All that I can convey about it is that it is more-or-less white, around 50cms on each side, sub-angular and has an unusual pitted texture – resembling a huge coral perhaps or enormous reptile bone! It reacted under cold hydrochloric acid. Not much to go on I know, but the rock can be viewed during normal museum opening hours. If, by chance, anyone has come across a similar example previously they are unlikely to have forgotten the encounter.

Unusual rock seen in the garden of Winkie's Castle. What is it?

If readers have any idea about the provenance of this rock you can email your suggestions to the editor at

cliff.rigg@gmail.com

From the Archive

The following is taken from a paper published in *Philosophical Transactions of the Royal Society of London (1776-1886).* (1882-01-01. 173:885–899) comparing meteorites from different parts of the world. Only details of the Middlesbrough Meteorite are included here.

XIX. *Report of an Examination of the Meteorites of Cranbourne, in Australia; of Rowton, in Shropshire; and of Middlesbrough, in Yorkshire.*

By WALTER FLIGHT, D.Sc, F.G.S., *of the Department of Mineralogy, British Museum, South Kensington.*

Communicated by H. DEBUS, Ph.D., F.R.S.
Received January 19, — Read February 9, 1882.
[Plate 53.]

XIV. THE METEORITE OF MIDDLESBROUGH, YORKSHIRE

During the past year a very beautiful specimen of a meteorite fell near Middlesbrough, in Yorkshire. It struck the earth at a spot called Pennyman's Siding, on the North-Eastern Railway Company's branch line from Middlesbrough to Guisbrough about one mile and three-quarters from the former town. Its descent was witnessed by W. Ellinor and three platelayers, who heard a whizzing or rushing noise in the air followed in a second or two by a sudden blow of a body striking the ground not far from them: the spot was found to be 48 yards from where they stood.

The fall took place on the 14th March, 1881, at 3:35 p.m. The wind was from the north-east, and it was a clear and bright but rather cold afternoon. At more distant places, as Northallerton and four miles to the eastward, the sound resembled the boom of a gun; no luminous or cloud-forming phenomena are reported. The character of the hole, according to Professor ALEXANDER HERSCHEL, who at once visited the spot, points to the fall having been vertical or nearly so. The stone was "new milk warm" when found, and weighed 3 lbs. 8 oz.; the dark surface is entirely fused and crusted, and has scarcely suffered by the fall. The stone forms a low pyramid, slightly scolloped, 6¼ inches in length, 5 inches wide, and 3 inches in height. The rounded summit and sloping sides are scored and grooved deeply with a polish like black lead, in waving furrows running to the base, showing that this side came foremost during the fusing action of the atmosphere which the meteorite underwent in its flight. The rear or base is equally fused or branded by heat, but is rough, dull brown in colour, and not scored or furrowed.

The meteorite penetrated the soil to a depth of 11 inches, and the penetration line apparently slopes about 10° from the vertical from the S.S.E.; it passed through 7 or 8 inches of coke- ballast, and thereafter brick-earth or coarse clay to the remaining depth. From experiments made by Professor HERSCHEL on the power of penetration of a cast-iron model of the meteorite, it is calculated that the actual velocity of fall with which the stone struck the ground must have been 412 feet per second, As it would acquire this velocity by falling freely through half-a-mile, it is clear how little of the original planetary speed with which it entered the atmosphere can have remained to affect its fall.

The interior of the stone has a greyish- white appearance, and is evidently for the most part composed of silicates: frequent bright metallic granules are to be seen, and they appear to be entirely or almost entirely granules of nickel-iron. The rocky portion varies from grey to pure white, of which there are patches, and while the greater part appears to be homogeneous in structure, there are many enclosed

chondra of large size and of a darker grey than the body of the stone.
In the well-developed markings of the exterior of the stone it bears a close resemblance, as Professor HERSCHEL points out, to the meteorite of Karakol (Kirgis Steppe, May 9th, 1840), of which Professor GOEBEL gives a figure in his paper of 1866 in the *Melanges physiques et chimiques de T'Academie Imperiale de St. Petersbourg/ vii., 318-324.*

The railway company, who at the time this notice was written retained possession of the stone, kindly permitted a few fragments to be removed for examination; and I shall now proceed to describe the results of the chemical analysis of them. It has since been presented to the Yorkshire Philosophical Society, and is now preserved in the museum at York.

XV. *The nickel-iron enclosed in the rocky constituents of the meteorite.*

A quantity was dried and weighed and treated with, mercury chloride, and it was found that 9.379 per cent, of constituents were removed. As already stated, when examined under a microscope the metallic particles appeared to consist entirely, or almost entirely, of nickel-iron. The nickel-iron was found to have the following composition:-

Iron	76.990
Nickel	21.320
Cobalt	1.690
	100.000

The remaining constituents, consisting of purely rocky matter, amounting to 90.621 per cent., are thus composed:

A. Soluble silicate	54.315
B. Insoluble silicate	36.306
	90.621

XVI. *The gelatinisable constituents of the rocky portion of the aerolite.*

The soluble portion and the silicic acid belonging to that portion was found to have the following composition:-

		Oxygen.
Silicic acid	41.100	21.92
Iron protoxide	27.960	6.213
Magnesia	30.940	12.380
	100.000	18.593

These numbers indicate the presence of one olivine of the form $2(^{1}/_{3}Fe, ^{2}/_{3}fMg)0, Si0_{3}$ or one closely resembling that which occurs in the Lance stone, which fell July 13th, 1872, and was examined by DAUBREE. No lime and no alumina were found in the soluble part, though carefully sought for.

XVII. *The insoluble silicates in the rocky portion of the Middlesbrough aerolite.*

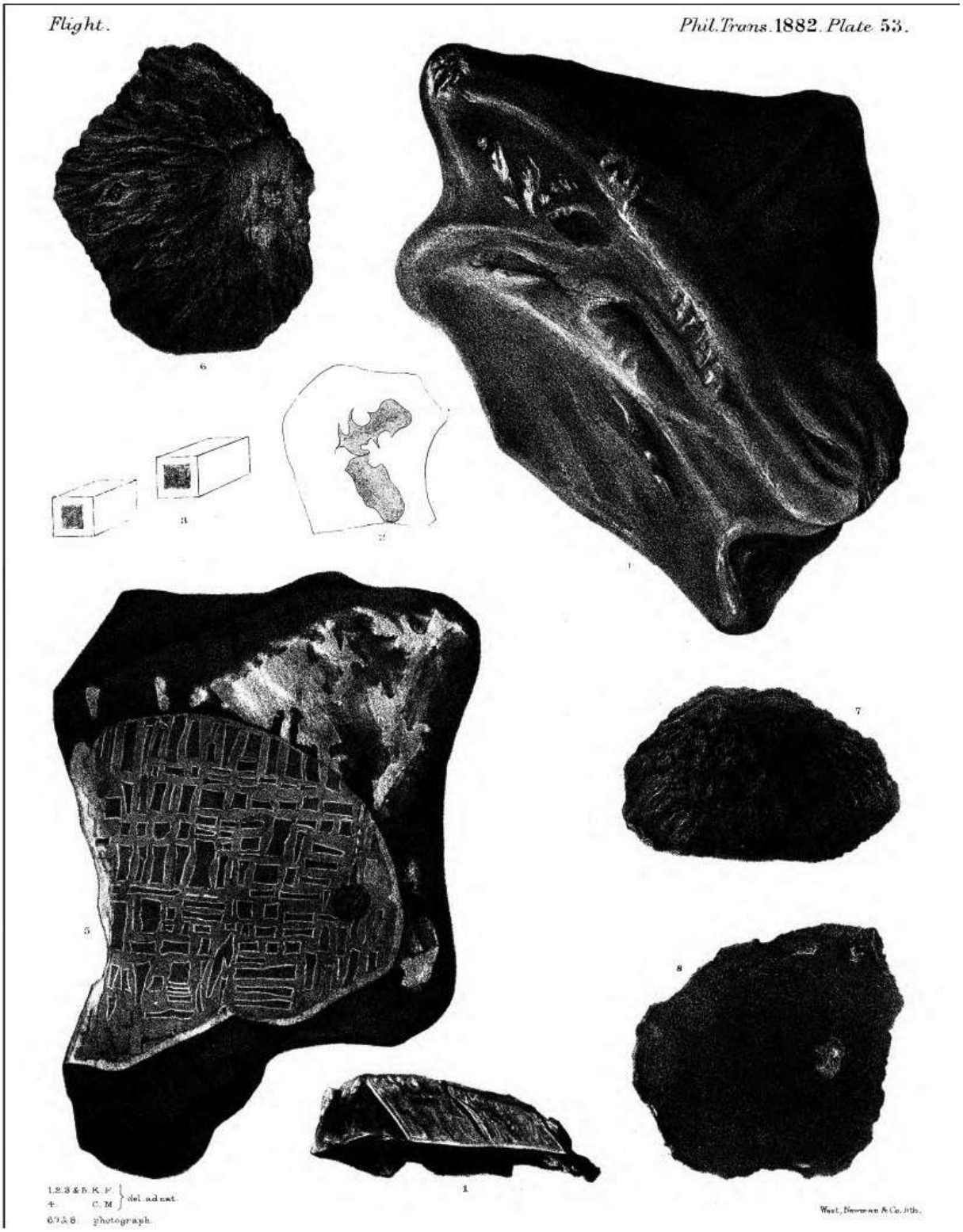
The constituents of the insoluble part were as follows:-

		Oxygen.
Silicic acid	55.389	29.541
Alumina, and a little chromium oxide	4.770	2.223
Iron protoxide	23.580	5.241
Lime	4.373	1.249
Magnesia	11.043	4.417
Alkalies	not determined	10.907
	99.155	

If the chief silicate in the above portion be regarded as bronzite it most closely resembles that met with in the meteorites of Iowa Co., Iowa, east of Marengo, which fell 12th February, 1875 f if, on the other hand, as is more probable, it be regarded as a lime-magnesia-iron augite it is closely allied to the augite of the stones of Stannern and Juvinas. The aluminous constituent is doubtless labradorite, and is probably present as some of the occasional chondra which are seen in a microscopic section of the meteorite.

In Plate 53 the front furrowed side is shown in figs. 6 and 7 and the back view in, fig. 8. They require no further explanation.

J. L. Smith, Amer, Jour. Sc. [3], vol. x., 1875, p. 363.


Flight.
Phil.Trans.1882. Plate 53.
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1,2,3 & 5. K. F. } del. ad nat.
4. C. M }
6,7 & 8. photograph.
West, Newman & Co. Hth.

The Lewis Hunton Project

The group's contribution to the Lewis Hunton Project, led by Mike Windle and colleagues at North East Yorkshire Geology Trust (NEYGT), came to a natural end in November with installation of an interpretation panel on the Cleveland Way. It bears information on Hunton's life and work, and the significance of the cliff side quarries. The board is located close to North Warren Cottages (formerly 'Tile Sheds') at NZ 7319 1971. Our thanks go to Josie Etches for allowing the board to be sited there.

On 9th November representatives of NEYGT, TVRIGS, Loftus Accord and Parish Council were joined by the Mayor, Councillor Mike Hodgson, at the site on a bright but blustery day. Following erection of the panel by Harry Guy and colleagues from SignArt a red ribbon was produced which the Mayor obligingly cut.

New interpretation panel near North Warren Cottage, Hummersea

Earlier in the year the two plaques commemorating Hunton's work were put up, one in the Market Place and a second on Hummersea Lane close to Hummersea Farm. Our thanks go to Loftus Parish Council and Vin Garbutt for their assistance.

Alan Simkins also led three guided walks into Loftus Quarries over the summer which were well received by all who ventured forth. Northumbria RIGS & OU, led by Karl Egerlund-Eriksson and Paul Williams, joined us on the final walk which departed from Skinningrove to take in the foreshore exposures and Alum House remains.

Lewis Hunton walkers admire the view from Gallihowe above Loftus Quarries

TVRIGS Chairman Alan Simkins and Vin Garbutt with the plaque at Hummersea

Redcar Blast Furnace

Closure of SSI's Redcar Blast Furnace, and coke ovens earlier this year was not only devastating for the workforce and local economy but marked the end of more than a century-and-a-half of iron and steel manufacture on Teesside.

The era commenced with the founding of Middlesbrough as a coal shipping port (Port Darlington) in 1831,usurping a trade that had until then been enjoyed by nearby Stockton-on-Tees. Around a decade later however the town's future hung in the balance as coal shipping moved to Hartlepool on the coast, obviating the need to navigate a still untamed River Tees.

Redcar Blast Furnace

At around the same time the partnership of *Bolckow, Vaughan & Co.* was formed who, in 1841, constructed Middlesbrough's first ironworks on land reclaimed from the river close to where the Transporter Bridge stands today. This was a bold venture given that (at the time) the nearest known sources of ironstone were on the coast near Staithes and alongside the River Esk at Grosmont. The true extent of the vast Cleveland Orefield was yet to be understood.

John Vaughan working with mining engineer John Marley traced the beds of ironstone inland from their outcrop on the coast, culminating in identification of the Main Seam on the north side of Eston Hills in 1850 - a find which proved a catalyst that

precipitated an episode of urban and industrial expansion which saw Teesside elevated to a world centre of trade and innovation.

Railway lines branched out across the Cleveland Hills to carry ironstone hewn at over 80 mines back to furnaces on the banks of the river where it was smelted and transformed at a burgeoning number of foundries, shipyards and fabrication shops into locomotives, ships, railway sleepers, bridges and a wealth of other essential infrastructure for dissemination across the globe.

Rationalisation began in the 1930s, when Dorman Long came to dominate, and two World Wars kept the industry ticking over for a few decades but cheaper high-grade imported ore meant that surviving mines were finally forced to close in the early-1960s, taking with them the remaining furnaces. Redcar Blast Furnace opened in the 1970s, rekindling Teesside's connection with the steel industry and standing for many years as a paragon of expertise and quality.

How the loss of Redcar Blast Furnace might affect Tata Steel's Special Profiles Division at Skinnigrove is not clear and, for now, Skinningrove continues to operate.

Durham Rock Remains a Mystery

The interesting cobble-sized rock found on the Durham Coast by youngster Lewis Kerr, and which featured in Issue 5, remains unidentified. The sample (shown below) may

Cobble-sized rock found on Durham Coast by Lewis Kerr

perhaps be either:

- a product of the Sunderland glass trade (note a blue glassy inclusion middle left).
- an exotic igneous rock (showing large crystal boundaries)perhaps brought within the ballast of a ship.
- or even a coralline limestone (but what about the glassy substance?).

No testing was able to ba carried out on the sample as Lewis would like to keep it entire. Application of dilute hydrochloric acid would help with discerning its calcite content (if any) and a thin section should (almost certainly) solve the issue.

Anyone with further information about the rock's possible origins are invited to contact Tees Valley RIGS Group through the usual channels.

Jurassic Plant Fossil Locality---Hasty Bank

by Alan Simkins

Yorkshire has many known Jurassic plant bed localities - some more famous than others. One of the more famous is at Hasty Bank in the Cleveland Hills located on the northern scarp overlooking Clay Bank and Stokesley.

Hasty Bank has been studied by several influential palaeobotanists since the 1920's and is still being actively investigated by Chris Hill [over a 40 year period he tells us].

TVRIGS has come to know Chris as a result of our Jurassic Plant Fossils at Marske Quarry project a couple of years ago and was delighted to take up his offer of a guided trip to Hasty Bank. As it transpired only five of us were able to make the trip - quality rather than quantity! The forecasted rain did not arrive either and we spent an enjoyable and informative four hours on site.

Chris kindly provided information on the geological context and of some of his investigations [see attached].

A head for heights was needed as we climbed up the heather-clad slopes of the Whitby Mudstone Formation to the junction with the Dogger, and then the Saltwick Formation above that. To the layman one surprise was the vertical extent of the recent excavations extending through more than 20 metres. Chris explained why, because the Dogger as well as the Saltwick was an essential element of the current research work - and the Dogger here can be some 5-6 metres thick.

Mattock point indicates Dogger Formation pebble bed

The purpose of this article is mainly to record a good day out [we must get out more!] and is not to describe in any detail the content of the current research effort [we await the research to be published] – but to paraphrase Chris's explanation there is a view that the Dogger and the lower part of the Saltwick could be seen as one environmental unit where fresh water and marine or intertidal conditions were to some extent repeated and interbedded. It is only in the higher levels of the Saltwick Formation - above the

second main sandstone outcrop at Hasty Bank - that a consistently non-marine depositional environment prevailed.
We finished our day at Hasty Bank by plant fossil collecting at one of Chris's trenches and it was instantly clear that "plant beds" is an accurate description of the concentration of compressed plant material here - the main component in the mudstones where we were being abundant *Equisetum*, but there were also leaves of *Ptilophyllum* and shoots of conifers. The flora as a whole has yielded some 80 species to date.
All in all a great day out—thank you Chris.

P.S. Two days later at Marske Quarry Chris and Andy demonstrated how plant fossils could effectively be 'mined' out of outcrops by finding and following the richer layers sideways [like mining 'seams']. As a result they found a first record in this quarry of the probable mangrove leaf *Pachypteris papillosa* from above the massive channel sandstones. By comparison with the sequence at Hasty Bank this suggests that the main sandstone at Marske is equivalent to the lower sandstone at Hasty Bank, as does the occurrence of abundant *Marattia* and of several other species together with the *Pachypteris* in the layers above. However the scarcity of *Pachypteris* and abundance of the conifer *Marskea* indicate a slightly more fresh-water phase than in the main plant bed at Hasty Bank. At Hasty, however, above the second sandstone the environment is even more fully fresh water; *Marskea* is also abundant there but *Pachypteris* no longer occurs.

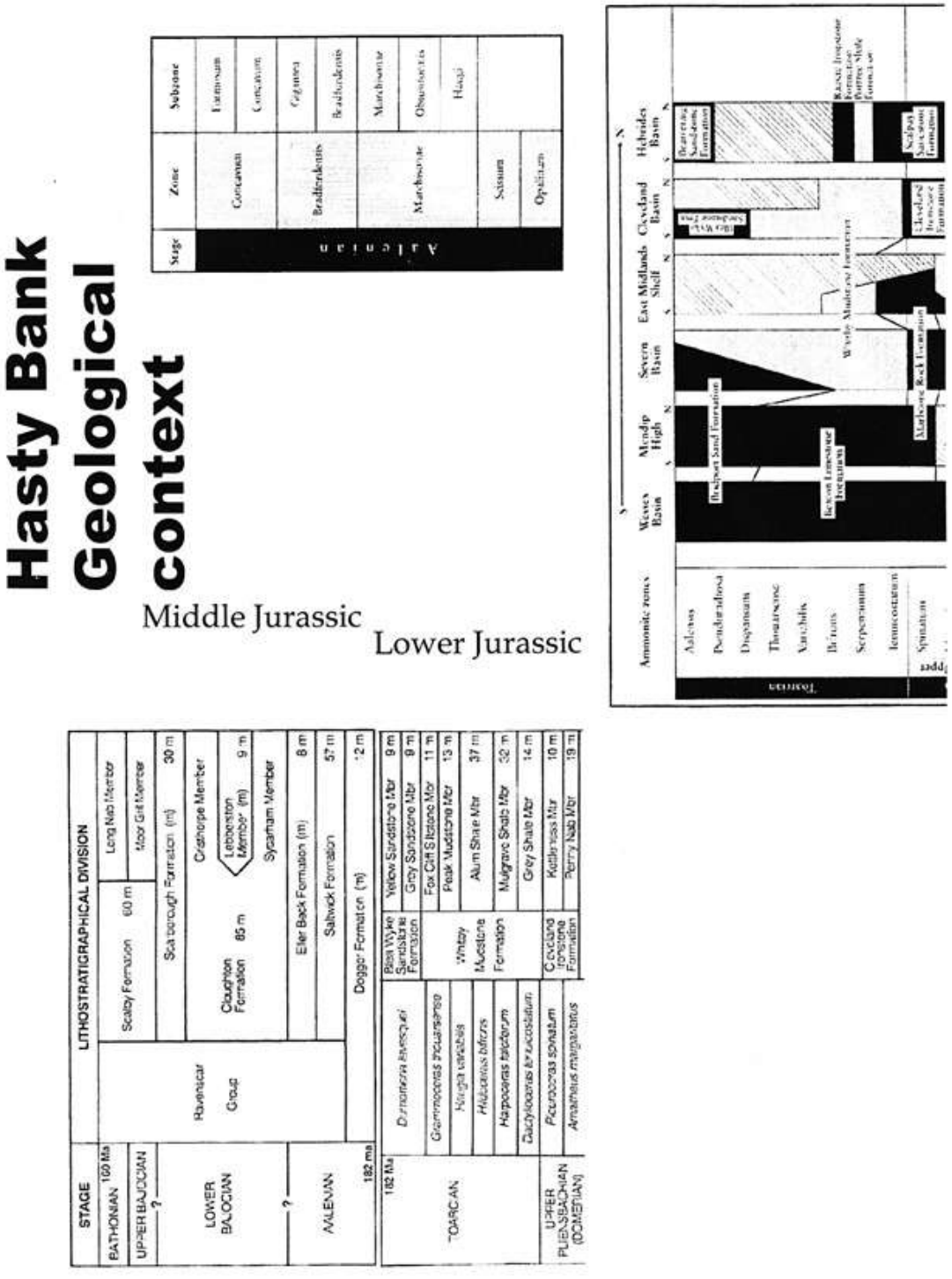
Plant fossils found at Hasty Bank - well preserved leaves of the cycad *Nilssonia kendalliae*

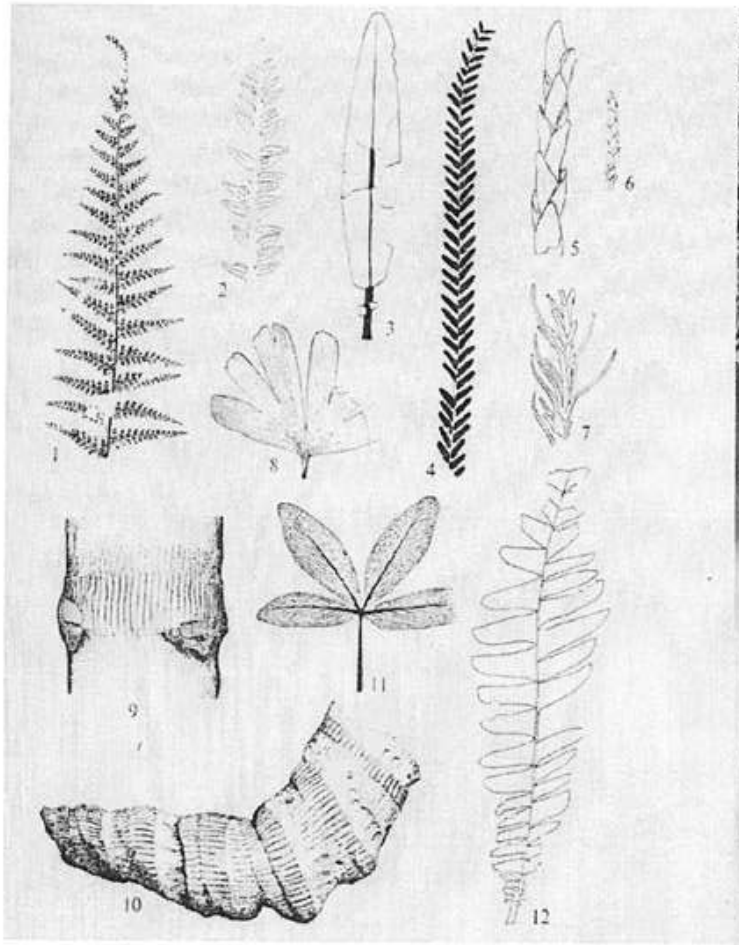


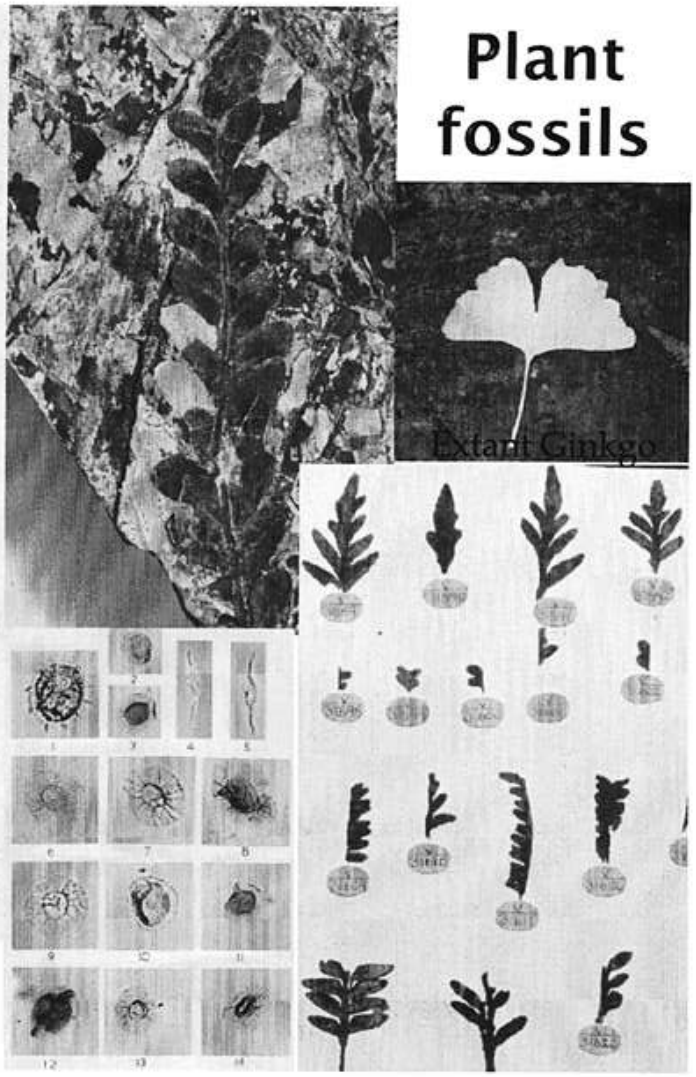


Montage of images from the day out at Hasty Bank

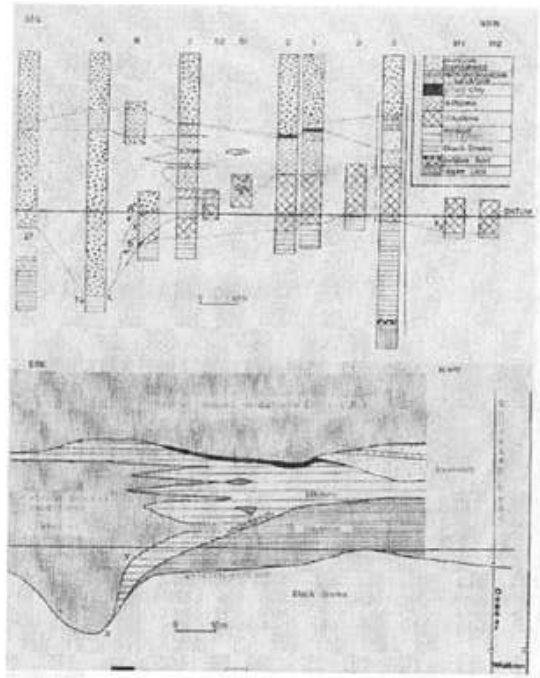
Notes prepared by Chris Hill for Hasty Bank







Not forgetting Jet [fossilised wood]!



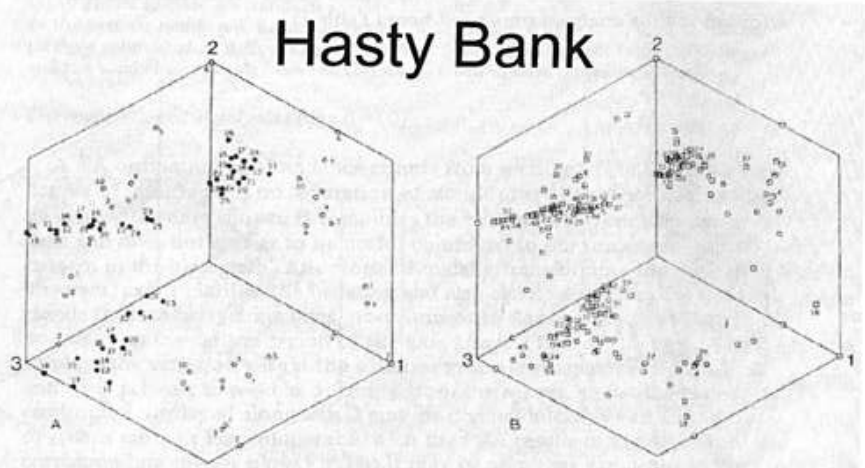
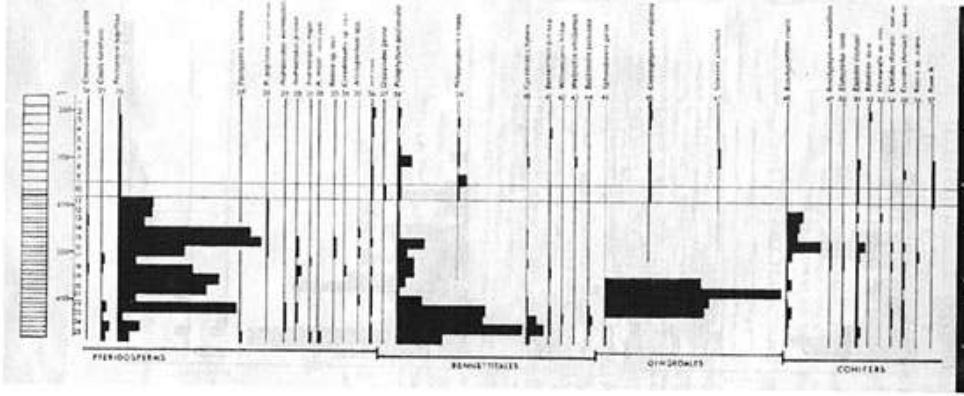
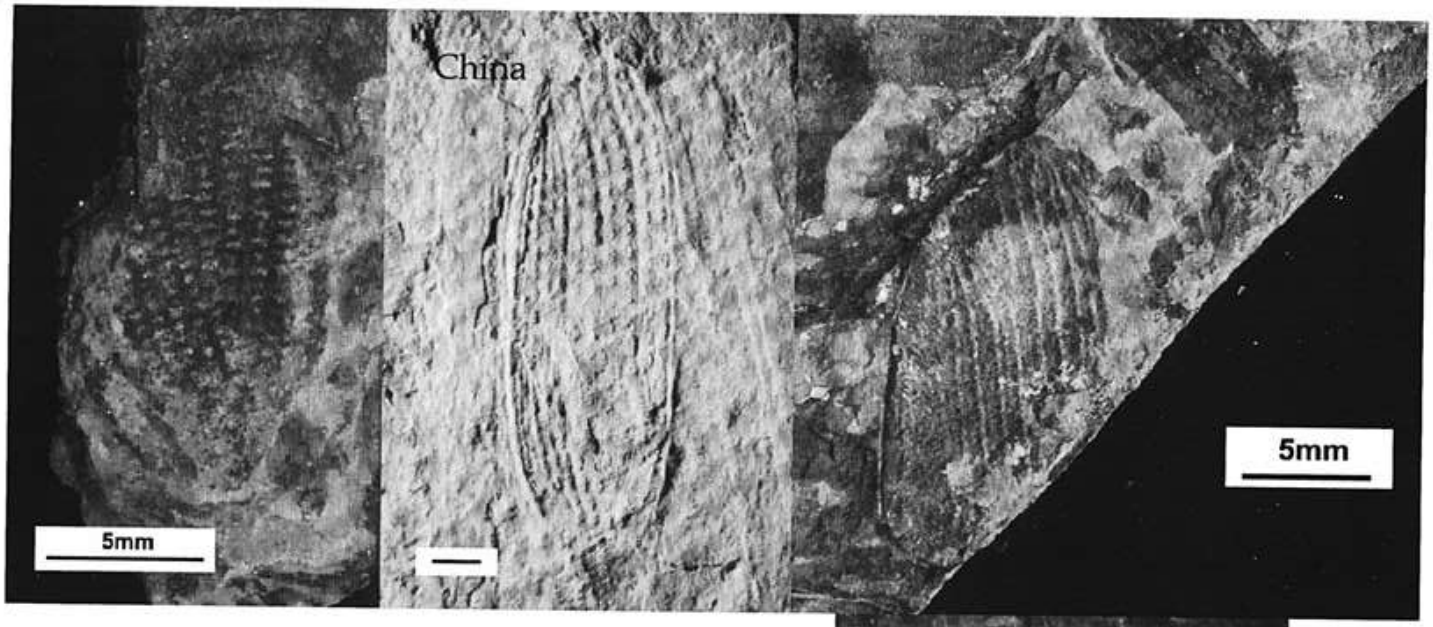


Fig.8. Correspondence Analysis ordination of the abundance data from Hasty Bank, section 1, based on the approximately logarithmic scale of 1—6 given in Table I. Eigenvalue axis 1, 0.41; axis 2, 0.25; axis 3, 0.22. A. Stand plot. B. Species plot.



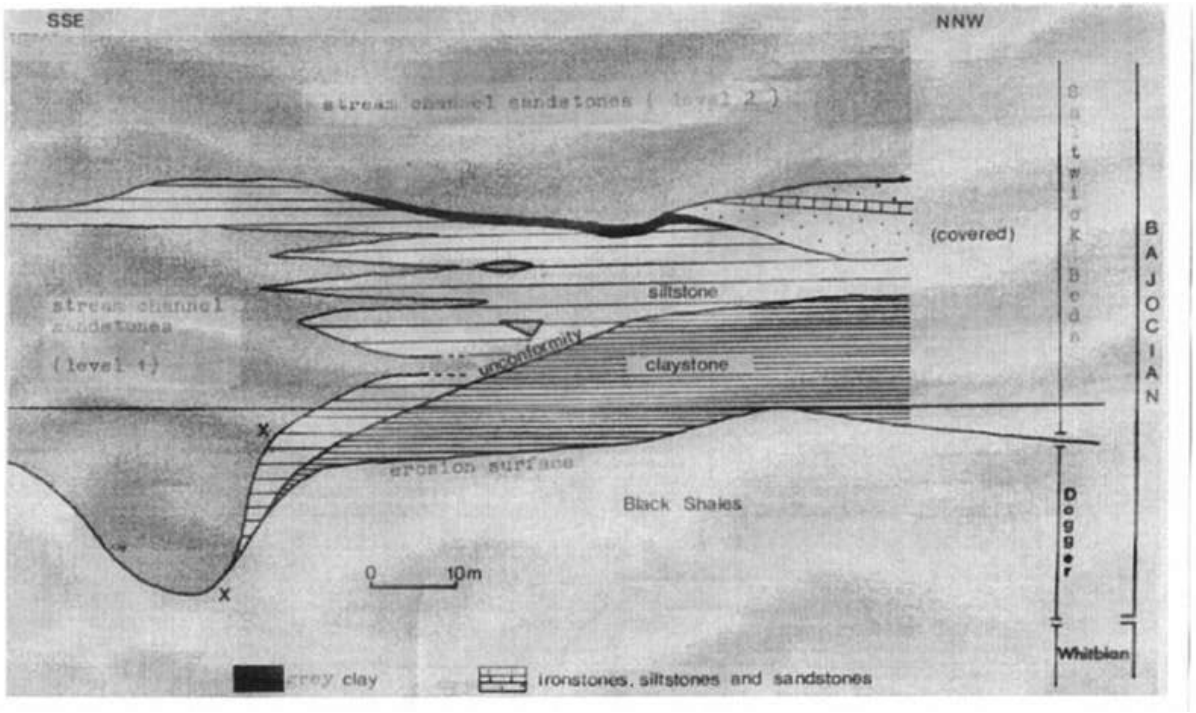


Sub orders
Archostemata
Polyphaga

Insects 2 and 3 from British Jurassic!

Will we fill this space?

g ovule of Marskea jurassica from the new locality at Botton Head, X20.



Sketches made by Chris Hill of the Hasty Bank site

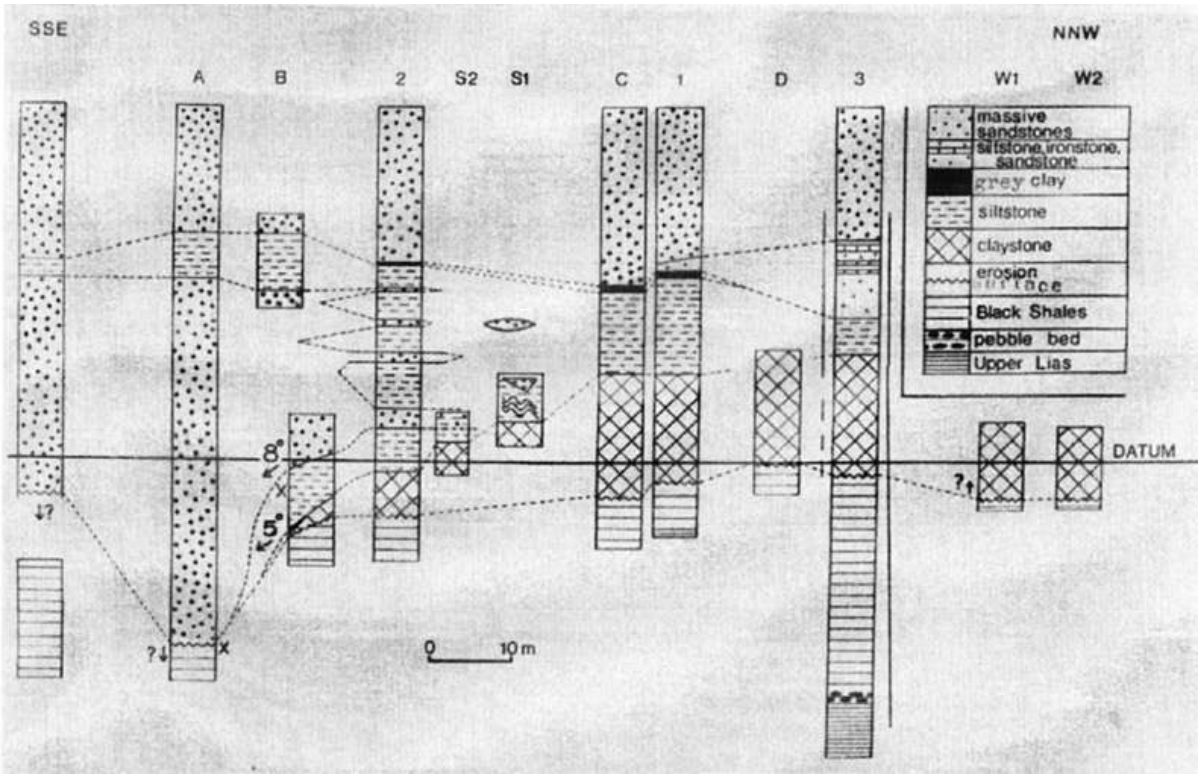
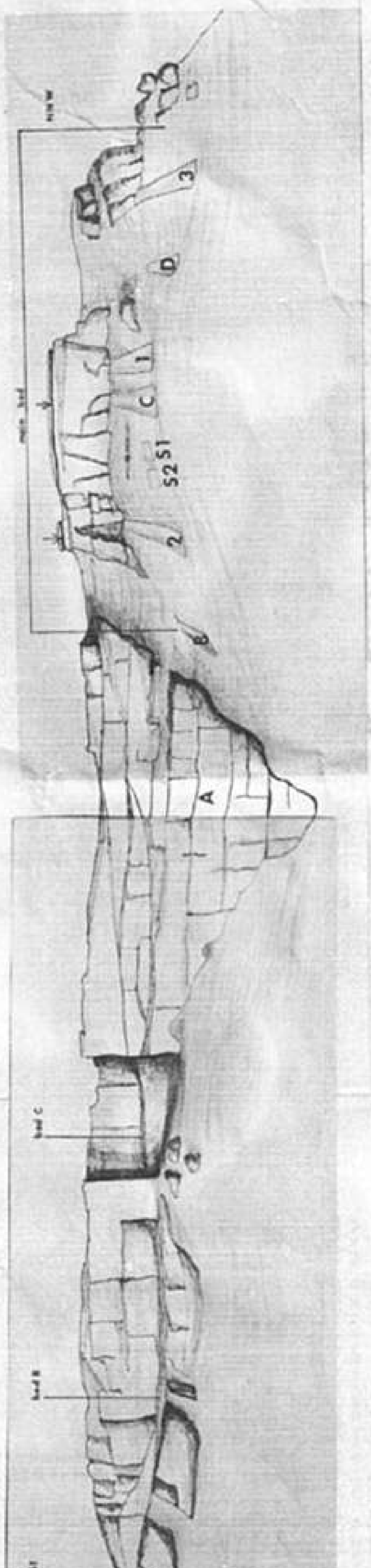


Fig. 5. For explanation see opposite



Roseberry Topping

Excerpts from the TVRIGS Site Management Plan compiled by Denis Goldring 2010

SUMMARY

Roseberry Topping is a well-known local landmark not far from the towns of Great Ayton and Guisborough. The area that forms the subject of this report includes approximately 1 km^2 of ground surrounding the summit and including two Regionally Important Geological (and geomorphological) Sites:

- RC22a **Roseberry Common** (NZ 584 128), TVRIGS data base no. 93
- RC22b **Newton Wood** (NZ 575 125), TVRIGS data base no. 17

The summit of Roseberry Topping is designated a Site of Special Scientific Interest (SSSI) and, in order to cover the area as an entity, details of it have been included. The reason for SSSI status is the Jurassic fossil flora localities that, in fact, only constitute a tiny proportion of the designated site.

The SSSI site and Roseberry Ironstone Mine, that has also been included in this report, are listed as follows,

- **Roseberry Topping summit**, SSSI (NZ 579 126), TVRIGS data base no. 16
- **Roseberry Ironstone Mine** (NZ 583 123), TVRIGS data base no. 159

The sites are designated for their educational, aesthetic, historical and research interest with the interpretation of the landscape on the basis of the underlying geology, geomorphology and past industrial activity being arguably most important. Taken together, the sites make up an interesting venue for geological excursions and there are several published guides including a 'geotrail'.

The Local Government boundary crosses the summit with the ground on the northern side being part of Redcar and Cleveland Borough Council whilst that on the southern side is part of Hambledon District Council in the County of North Yorkshire. The area forms part of the North York Moors National Park. The area where the RIGS and SSSI sites are located is owned by the National Trust and is designated as 'Open Access'.

There are a number of good public and National Trust footpaths and tracks and the area is extremely popular with walkers and fell runners. Access for cyclists and horse riders is limited to specific bridleways. Many people climb to the summit where there are stupendous views.

The main geological exposures are of deltaic and marine sandstones and jet shale. The Jurassic fossil flora localities are not to be disturbed but are in a poor condition for scientific research. All the sites are valuable for demonstrating the relationships between landscape, the underlying geology and the effects of industry. The views are especially good for demonstrating geology.

SITE DESCRIPTION

Roseberry Topping is a distinctive, isolated hill that is an erosional outlier of the main escarpment of the Cleveland Hills. It is formed of Lower and Middle Jurassic sedimentary rocks. The succession of softer shales and harder, more resistant to erosion, sandstones has given rise to a stepped profile and its outstanding shape gives it a special character that has led to many flowery descriptions and artistic interpretations.

Fig. 1 shows the general location and Fig. 2 the topography (the SSSI site is defined currently by the 800ft (244m) O.D. contour on the N., W. and S. sides of the hill).

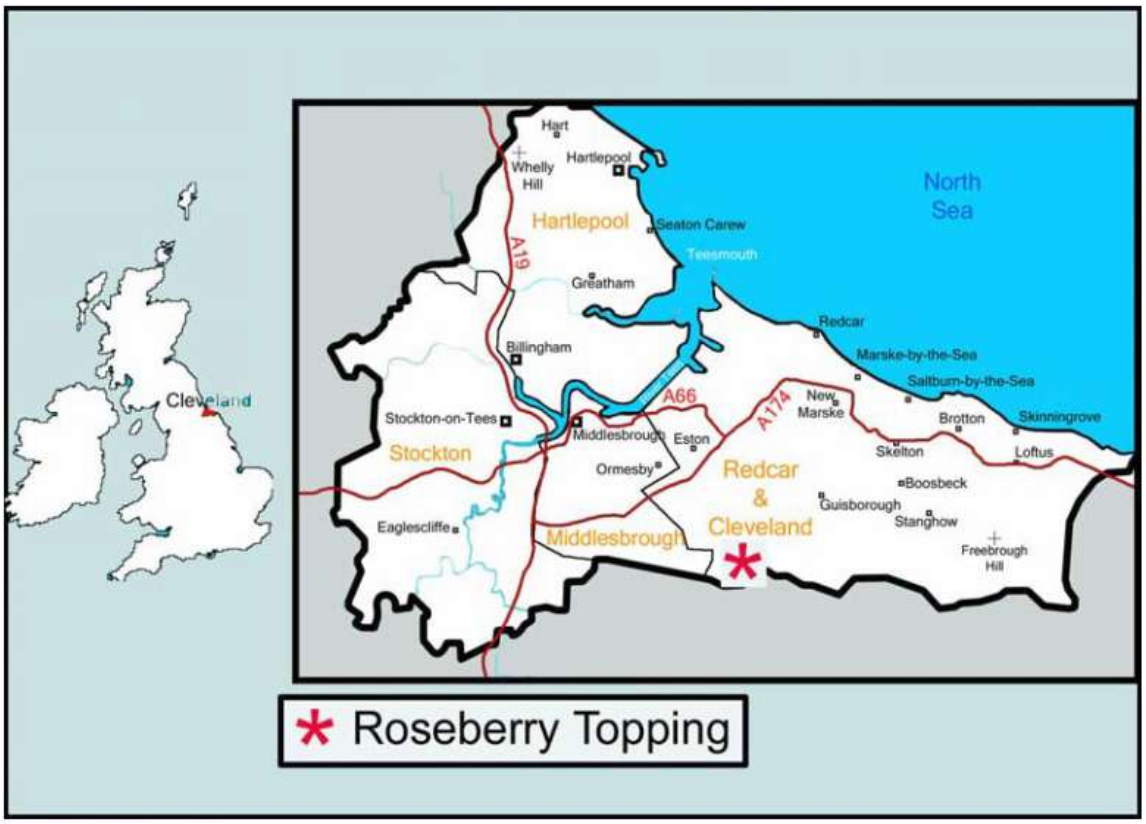


Fig. 1 The general location of Roseberry Topping

The area is of great landscape interest and there are superb views. Roseberry Topping summit is at 320m O.D., over 200m above the Tees plain. It is separated from the main escarpment of the Cleveland Hills (Little Roseberry and Newton Moor) by a col at 239m O.D. from which two broad valleys descend to the north and to the south.

The area is of importance from an industrial archaeological viewpoint as a result of the ironstone and jet mining and the sandstone quarrying that has taken place. Ironstone extraction has taken place under practically the entire hill whilst jet mining is confined to the margins.

Roseberry Topping is part of the ancient region known as Cleveland that was formerly in the North Riding of Yorkshire. The name is probably derived from the Old Norse ***Othenesberg*** (Odin's Hill). There are many comprehensive accounts of Cleveland including, for example, those edited by Spratt and Harrison (1989) and by Butlin (2003). The superbly illustrated book ***Roseberry Topping***, by the Great Ayton

Community Archaeology Project group (edited by Pearce, 2006), sets down practically everything that is known. Apart from scientific, historical, artistic and other connotations there is an aura to the hill represented at its simplest by the need to climb it at least once.

Although access is open and there are public footpaths, personal safety is paramount and the area has to be treated like any area of rough, steep terrain such as the 'Three Peaks' in the Yorkshire Dales and the Lakeland Fells of Cumbria. It can be very difficult in bad winter weather.

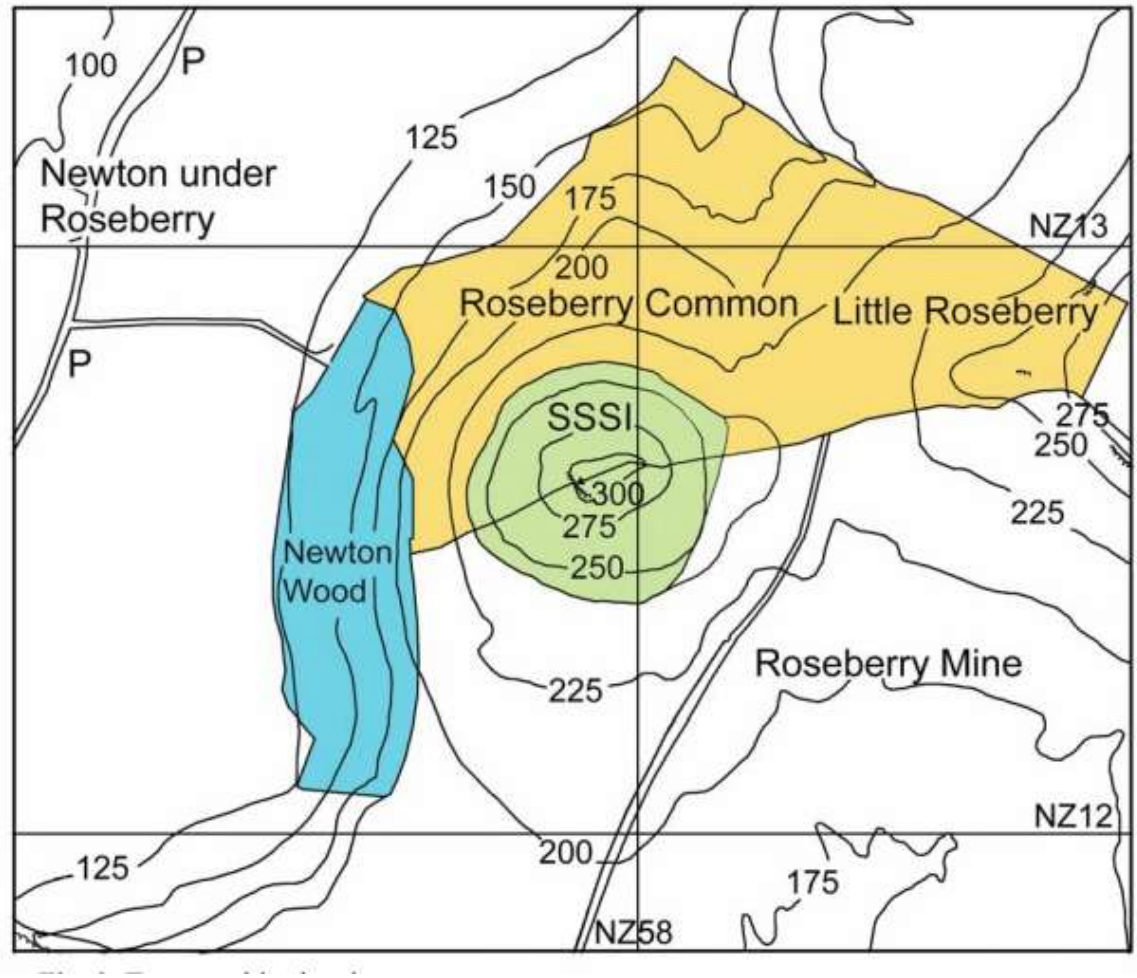


Fig. 2 Topographic Map of Roseberry Topping

GEOLOGY

Jurassic, bedded sedimentary rocks formed about 180 to 190 Ma (million years ago) immediately underlie the area. Table 1 shows the major subdivisions of the rocks in and around the area.

The rocks form part of a thick (~2000m) succession of sediments of the Cleveland Basin that were laid down – discontinuously - from about 290 to 50 Ma (the Cleveland Basin is part of a large intra-tectonic plate subject to extensional forces and crustal sagging during this time). The deposits are known from deep drill holes to rest on even older rocks (at least 400 Ma) and, from palaeo-geographic evidence, to have been

subsequently uplifted and partly eroded away (the Chalk, for example, is believed to have originally been present). Further uplift, fluvial erosion and the effects of the glaciations of the past 3 Ma gave rise to the present topography.

The strata are inclined at a slight angle (a few degrees) to the east. A few relatively small faults (locally termed 'hitches') are known to be present from the mining with throws of up to a few metres. Only one has been mapped at the surface.

Fig. 3 is a geological sketch map of the area and Fig. 4 a sketch geological section. The names used here are in modern usage (as defined, for example, by Cox, Sumbler & Ivemey-Cook, 1999). It should be noted that earlier editions of the geological maps and reports use other, now obsolete nomenclatures. Also, the majority of the stratigraphic information is derived from the superb coast exposure that is not necessarily applicable far inland. In general, in the Lower Jurassic (Lias) the area formed part of a sub-tropical sea and marine sediments were deposited. Subsequently, in the Middle Jurassic, the area was subject to uplift and became a huge delta with flood plain deposits, thin coal seams and river channel deposits as well as occasional relatively thin layers of sediments resulting from short-lived marine incursions.

Table 1. Major rock subdivisions

Group	Formation	Typical thickness (m)
Pleistocene	Devensian	0-50
Ravenscar (Middle Jurassic)	Cloughton	50
	Eller Beck	0-8
	Saltwick	50
	Dogger	0-5
Lias (Lower Jurassic)	Whitby Mudstone	75
	Cleveland Ironstone	30
	Staithes Sandstone	25
	Redcar Mudstone	260
Penarth (Upper Triassic)		~6

Some of the Jurassic strata are of particular interest for past economic and modern geological research reasons. These include particularly the ironstone seams within the upper part of the Cleveland Ironstone Formation, the Jet Rock, considered to represent a period of global warming; the Dogger Formation with its complex lithostratigraphy and absence in the Roseberry Topping area, and the Saltwick Formation that includes sandstones used for local building and the important Jurassic fossil flora localities.

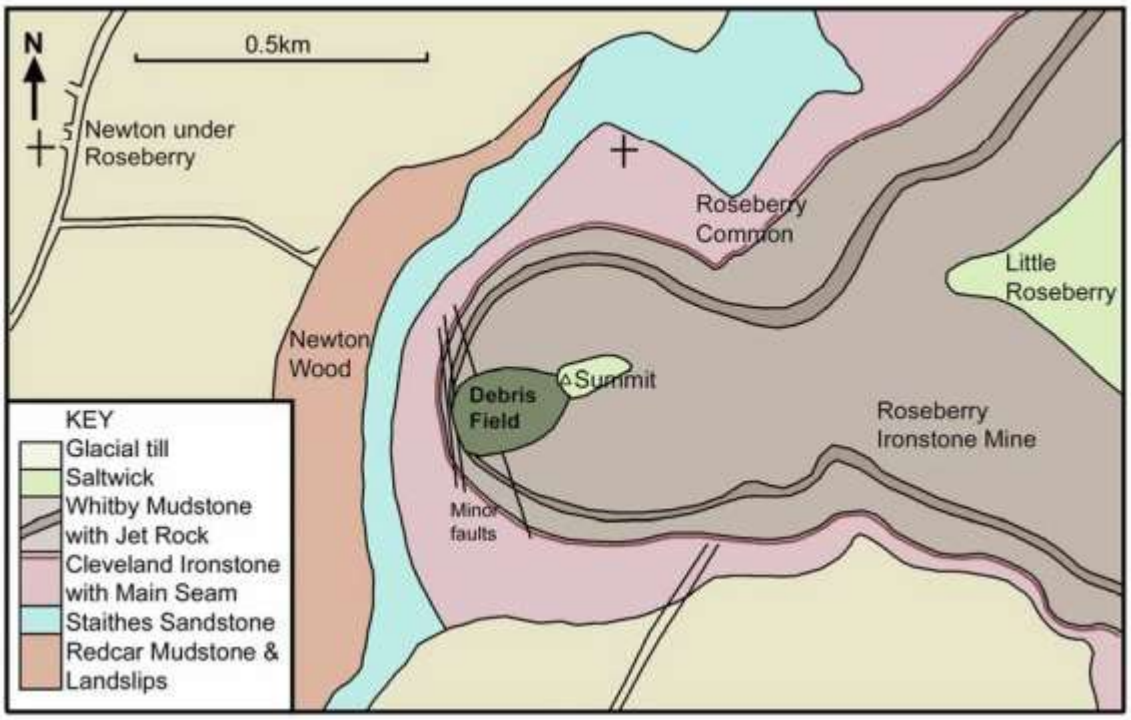


Fig. 3 Geological Sketch Map of Roseberry Topping

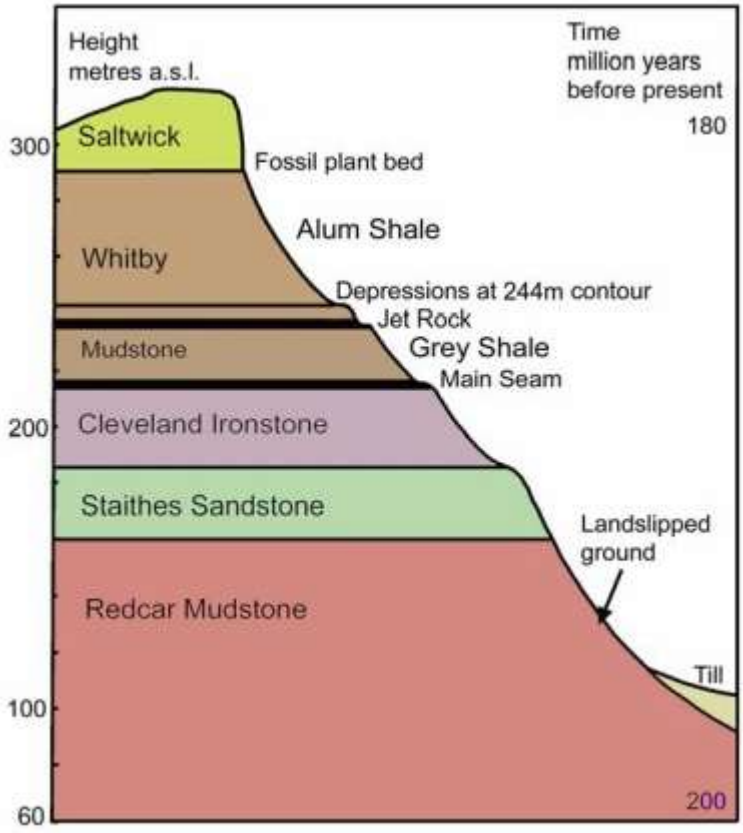


Fig. 4 Sketch Geological Section

With regard to the glacial geology, the Tees plain to the north-west was over-ridden by the Devensian ice sheets (c. 120k to 12k B.P.) that were banked up against the relatively ice-free Cleveland Hills (Kendall, 1902) and Roseberry Topping may have formed an

ice-free nunatak. Glacial till (clay with pebbles and gravel lenses) forms the low ground around the outlier and extends in places up to 150m O.D. and possibly higher (recent augering found till locally at 250m O.D., Pearce, 2006) on the north-west side and over 220m O.D. on the southern flank. However, erratics may be present at higher levels (some are present by the footpath near Aireyholme Cottage at about 195m O. D. (NZ 577 118). A late Devensian glacial drainage channel has been identified in the Slacks Wood area immediately to the south-east.

The reason for the isolation of Roseberry Topping from the main escarpment is conjectural. There are various possibilities, for example:

- The intervening eroded ground may have been formed of softer, less resistant Middle Jurassic flood plain deposits rather than resistant channel sandstone.
- The glacial flow pattern may have isolated the hill as a nunatak.
- Pre-glacial wasting of the escarpment was accelerated locally by the development of the side valleys on either side of the col.

Fig. 5 Looking east from the summit ridge down on to the jet shale quarries with Little Roseberry and Newton Moor beyond

In post-glacial and modern times the Roseberry Topping area has been subject to landslides, particularly on the western face of the summit area and the north facing slopes of Newton Wood and Cockle Scar. The large 1912 slip seems to have been responsible for the present asymmetric, pleasing shape. It has been attributed by some to the ironstone mining.

Roseberry Common (RC22a, NZ 584 128), TVRIGS no. 93

This is an expanse of 'open access' land extending from near to Roseberry Lane to Little Roseberry on the edge of the Cleveland Hills escarpment (Fig. 5). It is underlain by the

full succession of Jurassic strata (Redcar Mudstone Formation to Saltwick Formation) but only the Jet Rock is well exposed. There are many landscape features, including the terracing, col and landslipping below Cockle Scar. The area is partly underlain by mine workings (above approximately 225m O.D.) and there are numerous archaeological and unexplained archaeological/geological remains.

Newton Wood (RC22b, NZ 577 124, TVRIGS database no. 17)
The site consists of pleasant woodland (it is designated as a SNCI) mostly on the steep north-facing slope of the Staithes Sandstone escarpment. There are crags of thinly bedded, marine sandstone with some fossil-rich lenses that are accessible in a few places with some difficulty but the main interest is, arguably, in the extensively land-slipped lower ground.

Roseberry Topping (SSSI, NZ 579 126, TVRIGS database no. 16)
This is the summit area of the outlier consisting of massive, deltaic channel sandstone (Saltwick Formation) underlain by shales (Alum Shale of the Whitby Mudstone Formation) (Fig. 6). It is a marvellous viewpoint.

There has been some quarrying for building stone that is at least partly responsible for the shape of the hill although major slips of 1871 and 1912 were probably more effective. The famous fossil plant localities at the base of the sandstone are the reason for SSSI status. These were exposed first as a result of the 1912 fall. They must not be disturbed but is, in any event, are no longer in a fit state for serious collecting. The area is subject to ground instability. There have been several rock falls including one as recently as 1979.

Roseberry Ironstone Mine (NZ 583 123, TVRIGS database no.159)
This is the surface remains of the ironstone mine the workings of which extend over the whole area bounded by, approximately, the 225m contour.

Fig. 6 View from the south-west showing the sandstone cliff face and boulder field

HISTORY

General

The history of Roseberry Topping has been covered fully by various contributors (e.g. Chapter 14, ***Industry on Roseberry*** by R. de Wardt and D.W. Taylor) to the book ***Roseberry Topping*** (2006) that also includes numerous references to primary sources and previous accounts.

In brief, the history of human presence goes back to Mesolithic times and some of the pits, labelled 'British Settlements' on early Ordnance Survey maps, provide possible evidence for early occupation. Otherwise much of the historical documentation refers to the substantial antiquarian and artistic preoccupation with Roseberry Topping both in reality and in spirit.

The only building now close to the hill is the 'Shooting Lodge', 'Summerhouse' or 'Prospect House' (NZ 577 124). It may well have been used for all these purposes, the last referring to it originally being built as a poor man's version of the Rievaulx 'temples'. It is constructed on a platform of made ground probably from the Cleveland Ironstone Formation outcrop to the north. The sandstone building is likely to have been constructed in the late 18th Century.

Roseberry Well (NZ 579 126) is also a noteworthy historic feature. It is at the foot of

the Saltwick Formation sandstone but is now little more than a damp patch.

Antiquarian sources refer to various 'buildings' actually at the summit including a 'hermitage' or 'grotto', a 'forge' and 'St Winifred's needle' (probably a narrow passage through the sandstone face). These have all disappeared as a result of the quarrying or rock falls (Ord, 1846).

INDUSTRIAL HISTORY

Ironstone

This has been described briefly by Tuffs (1996) and, in detail, by Pepper (1999). Mining took place during two periods, during 1871-1887 by (1) Norton Iron Co., (2) Roseberry Ironstone Co. and (3) Stevenson, Jaques and Co. and during 1906-1926 by (4) Tees Furnace Co., (5) Burton and Sons and (6) Gribdale Mining Co.

Relatively little was done during the first period, the total mined being only about 47,000 tonnes. The mine site with drift entrances is to the south of Roseberry Common (NZ 583 123) and there was a tramway to the railway line near Great Ayton including an incline alongside Cliff Rigg.

The mine was reopened in 1906 and in the period to 1921 a considerable tonnage was won so that the abandonment plans shows the workings in the Main Seam to have been mostly goafed (i.e. the pillars have been removed). Some mining also took place of the underlying Two Foot Seam in the vicinity of the drift entrances.

There were at least two landslips on the face of Roseberry Topping (in 1873 and 1912) that were blamed on the mining although this has been denied (Burton, 1925).

Jet

There is a line of jet mines and associated tips around much of Roseberry Topping at approximately 240m O.D. as well as the quarries on Roseberry Common. These most likely date from late Victorian times. Jet working has been described by, for example, Owen (1975).

Sandstone

It seems possible that, although evidence is scanty, there has been a considerable amount of quarrying of sandstone for building in the summit area. Currently, there is definite evidence for quarrying on the south side of Roseberry Topping just below the summit where there are tooled herringbone pattern marks on the faces on both sides of the main path. This location is marked as a sandstone quarry on the First Edition, 1:10,560 scale O.S. map of 1856. There are, however, earlier references to quarrying particularly on the west face and it has even been suggested that the summit has been lowered as a result (Ord, 1846).

References

Barrow, G. 1888. The Geology of North Cleveland. Memoirs of the Geological Survey. Great Britain, HMSO, London. 101p.

Burton, J. J. 1925. Roseberry Topping in fact and fiction. Proc. Cleveland Naturalists Field Club, 9 (1910-1925), 190-205.

Butlin, R.A. (editor). 2003. Historical atlas of North Yorkshire. Westbury, Otley, 296p.

Cox, B. M., Sumbler, M. G. and Ivimey-Cook, H. C. 1999. Research Report Number RR/99/01, 'A formational framework for the Lower Jurassic of England and Wales (onshore area)', British Geological Survey, available on the internet.

Fox-Strangways, C. 1892. The Jurassic Rocks of Britain, Volume 1, Yorkshire. Memoirs of the Geol. Surv. Great Britain, HMSO, London, 551p.

Frost, D. V. 1998. Geology of the Country around Northallerton. British Geological Survey, HMSO, 109p.

Goldring, D. 2006. Along the Esk. Peter Tuffs Publications, 168p.

Kendall, P. F. 1902. A System of Glacier-lakes in the Cleveland Hills. Quart. Journ. Geol. Soc. London, 58, 471-571.

Ord, J. W. 1846. History and Antiquities of Cleveland. Simpkin & Marshall, London, 623p.

Owen, J. 1975. Jet Mining in North-east Yorkshire. Cleveland Industrial Archaeologist, No. 3, 13-22.

Pearce, I. (editor) & Cornish, J. (photography). 2007. Roseberry Topping. Great Ayton Community Archaeology Project, 206p.

Pepper, R. 1999. Roseberry Ironstone Mine. Peter Tuffs Publications, 32p.

Rawson, P. F. and Wright, J.K., 2000. The Yorkshire Coast. Geologists' Ass. Guide No. 34, 130p.

Tuffs, P. 1996. Catalogue of Cleveland Ironstone Mines. Peter Tuffs Publications, 56p

Spratt, D. A. and Harrison, B. J. D. (editors). 1989. The North York Moors Landscape Heritage. David and Charles, Newton Abbot, 232p.

Senior, J and Rose, J. 1994 (revised 2006). Chapter 11 in 'Yorkshire Rocks and Landscape', ed. C. Scrutton. Ellenbank Press, 110-118.

CNHS AND TVRIGS joint Field Meeting Whitby to Saltwick Bay16th Sep. 2015.

By John Waring

Whitby East Cliff and Abbey

Background Information

The rocks to be examined were laid down between about 180 to 170 Ma; i.e. they took about 10 million years to be deposited. The regional geography was, of course, quite different from todays. Factors affecting changes in geography and climate are the Milankovitch Cycles (the Earth's eccentricity, axial tilt and precession), plate tectonics, uplift, erosion, deposition and changing sea levels, either relative or absolute.

Throughout the Jurassic period the North York Moors area was a subsiding area, known as the Cleveland Basin which formed part of a system of continental shelf shallow sea areas. It was bounded to the NE by the Mid-North Sea High, to the west by the Pennine High. To the south lay the East Midlands Shelf.

During late Cretaceous-Tertiary times, c.65Ma, the Basin underwent uplift and inversion. Inversion has resulted in the Cleveland Hills forming a broad east-west trending anticline with subsidiary synclines, domes and anticlines. It is estimated that up to 2km. of sediments have been eroded in the last 65 million years.

Lower Jurassic times are characterised by fluctuating sea-levels resulting in small and large scale coarsening up cycles due to basin tectonics and/or climate change. Middle Jurassic times are characterised by a prograding delta or coastal plain, interrupted by marine transgressions.

During **Whitby Mudstone Fn.** (Toarcian) times (commencing c.180Ma.), the Cleveland Basin continued to subside & a global rise in sea-level resulted in deposition of mudrock the Whitby Mudstone & Blea Wyke Sandstone Formations. Gentle folding ensued together with submarine? erosion. Subsequently, further sedimentation took place with the deposition of the **Dogger Fn.** which here lies unconformably on the Alum Shale Member. (The upper part

of the WMF (i.e. the Peak Mudstone and Fox Cliff Siltstone Members and the whole of the Blea Wyke Sandstone Formation are missing, c. 42m.

Saltwick Fn. A predominantly terrestrial environment followed, with a delta or a coastal plain prograding (advancing) from northerly and north-easterly directions. The deltaic environment consisted of distributary river channels which eventually became choked with sediment leading to the initiation of more channels together with floodplain and crevasse splay deposits (sandstones & shales), and thin coals.

The Traverse

The party assembled at the bottom of the Abbey Steps and proceeded to the east pier where the contrast between the cliffs to the west and east was noted. The west cliff consists of multi-storey channel sands incised into each other whereas the east cliff consists predominantly of evenly bedded sandstones alternating with siltstones and shales.

The contrast could be due to a fault, running almost parallel (north-south) to the harbour and downthrowing to the west by about 12m. It has been proposed (J. Alexander) that the fault was active during the Middle Jurassic resulting in a lower lying area to the west repeatedly occupied by river channels.

East cliff: Level bedded sediments of the Saltwick Formation

West cliff:Multi-story channel sand bodies

With the tide now beginning to recede the traverse began at about 11.10 am along the wave cut platform, here consisting of the Alum Shale Member of the Whitby Mudstone Formation. The distinctive small fossil, *Dacryomya ovum* (formerly *Nuculana ovum*), which Louis Hunton used as a guide for the best shale from which to manufacture alum, was found as well as belemnites.

Dacryomya ovum

The overlying Middle Jurassic Dogger Formation with its sharp erosive base unconformably overlying the Alum Shale member was also noted. It was pointed out that at least 42 metres of underlying deposits, viz. the Peak Mudstone, Fox Cliff Siltstone Members and Blea Wyke Sandstone Formation were missing. It remains conjectural as to whether erosion of these sediments was subaerial or submarine.

The party then proceeded towards Long Bight where, immediately before a large rock fall, a broad channel sandstone was seen. It was noted how the channel had cut into the underlying Dogger Formation and that its western side was marked by thick easterly dipping cross-sets; the leader illustrated how they are interpreted as point bar deposits as the channel meander migrated eastward.

The large rock fall, where the Dogger Fn. rises westward in the cliff, consists of pale grey sandstone blocks. They have fallen from just above the Dogger and contain fossil flora (Whitby Plant Bed). Unfortunately, there was insufficient time to permit searching for plants although a few fallen blocks with carbonaceous remains were seen.

Unfortunately, masses of seaweed prevented a close examination of the Dogger Formation, a tough siderite sandstone with a pebbly base. U shaped tubes burrowing from the Dogger

Formation into the Alum Shale Member (*Diplocraterion* or *Thalassinoides*?) could have been examined as well as the basal conglomerate. Photos showing these features were shown instead.

Western side of channel sandstone almost washing out underlying Dogger Formation

Between Long Bight and Rail Hole Bight dinosaur footprints have been found on fallen blocks. Unfortunately, again, masses of seaweed prevented safe access for examination.

The party then moved on to the eastern end of Jump Down Bight. Here, the *Ovatum* band, a double row of pyrite skinned concretions, some containing the ammonite *Ovaticeras* marks the transition from the Hard Shales to the underlying Bituminous Shales (top of the Mulgrave Shale Mbr.). Unfortunately, most of the concretions were conspicuous by their absence.

Since the tide was beginning to come in a brisk walk was made to Saltwick Nab. After clambering over the "neck" a more leisurely examination of the Mulgrave Shale Member took place. It was here that the party encountered a group of geologists, some professional, who were involved in the "Mud, Glorious Mudstone" project related to oil and gas exploration and organised by Durham University. Squashed *Harpoceras* & *Pseudomytiloides*, many pyrite skinned, were seen.

Conglomerate at the erosive base of the Dogger Formation with Diplocraterion? Burrow

At the Low Water mark a reef, the Top Jet Dogger, consisting of a tough limestone overlain by the "Millstones", very large circular limestone concretions were examined. Discussion took place as to how the latter may have formed. The Top Jet Dogger was used in some places as a natural roof for mining Jet. Here, however, jet was quarried on the shore at times of extreme low water.

In Saltwick Bay, remains of the alum industry were seen, including a conglomerate known as "slam", a waste product of the alum industry. Two years previously, the leader was shown by the late Dr. Martin Whyte a loose block of sandstone, just east of the Nab, with two large sauropod prints. Efforts were made to find it, but without success.

Eastern side of Saltwick Nab

Large pyritised fossil, found on east side of the Nab: probably Peronoceras heterophyllum. c.30cm diameter

It was pointed out that centre of the bay consists of a glacially filled valley, probably the original course of a pre-glacial river. It extends seawards as a channel known as Saltwick Hole.

The party then climbed up to the holiday park at the top of the cliff and walked back to the Abbey Steps, taking note of how rapidly the tide had come in on the west side of Saltwick Nab.

Sandstone block just east of the Nab, with two large sauropod prints. Photo taken 2012

Events Diary

This issue's events take place at the Hancock Museum, Newcastle in 2016.

Quaternary Fluvial Archives: a new paradigm. Talk by Prof Dave Bridgland

29th Jan 2016
Friday 29 January, 7pm-8pm
Great North Museum: Hancock

Work over the past few decades has pulled together geological and geomorphological records from rivers in the Quaternary Period that show interesting patterns of similarity and difference, which can be related to climate, its zonation and fluctuation, and to crustal provinces. Quaternary ice ages have influenced our landscape far beyond the immediate reach of the ice sheets themselves.

David Bridgland is a Professor in the Department of Geography at Durham University, with research interests in Quaternary environmental change and fluvial history, with reference to palaeontology and archaeology. Until recently he was President of the Geologist's Association.

Geology & War

30th Jan 2016
Saturday 30 January, 1pm-4pm.
Great North Museum: Hancock, Newcastle

The unequal global distribution of geological resources (including hydrocarbons, industrial minerals and water) is partly to blame for many wars. Once conflict erupts, terrain, bedrock geology and ground conditions become key military considerations - wars are won and lost 'on the ground'. In the aftermath, geologists can advise on remediation of contaminated ground and the safe disposal of nuclear weapons and other toxins. Looking forward, can geology help with conflict avoidance?

Join Peter Doyle, Noel Worley and Andrew Morrison to explore Geology and War. This is a free joint event run in partnership with the Yorkshire Geological Society. A more detailed programme will be available here closer to the event.

The retreat of the North Sea Ice lobe: New seafloor evidence from the Britice Chrono project. Talk by Dr Dave Roberts

26th Feb 2016
Friday 26 February, 7pm-8pm
Great North Museum: Hancock

The ice sheet history of the east coast of the UK and western North Sea has long fascinated geologists. During the last glacial cycle the North East was overrun by the British-Irish Ice Sheet (BIIS) flowing eastwards and southwards. In recent years it has become evident that several ice streams including the Tweed, Tyne, and Stainmore Gap ice streams, as well as the late stage North Sea Lobe, played a role in shaping the landscape. Understanding the flow phasing of these ice streams is important for understanding the dynamic behaviour of the BIIS and ice sheet collapse patterns. Here we present new data from the seafloor collected during recent work undertaken by the BritIce Chrono project in the North Sea.

Dave Roberts is a Senior Lecturer in the Department of Geography at Durham University. His research interests centre on glacial sedimentary processes, subglacial processes and controls on ice sheet and ice stream dynamics, in Greenland and the UK.

Fossil Collections Tour, Newcastle

9th Mar 2016
Wednesday 9 March, 2pm-3pm
Discovery Museum, Newcastle

Sylvia Humphrey is the curator of the Natural History Society of Northumbria's geology collections, the majority of which are held in special stores in the basement of the Discovery Museum in Newcastle. This is a fantastic opportunity to see some of the fossils that have come to us via notable 19th century collectors such as William Hutton and Thomas Atthey. We will see examples of a variety of fossils, including fish and plants. Free but booking is required to manage numbers. Please contact the Society Office to book.

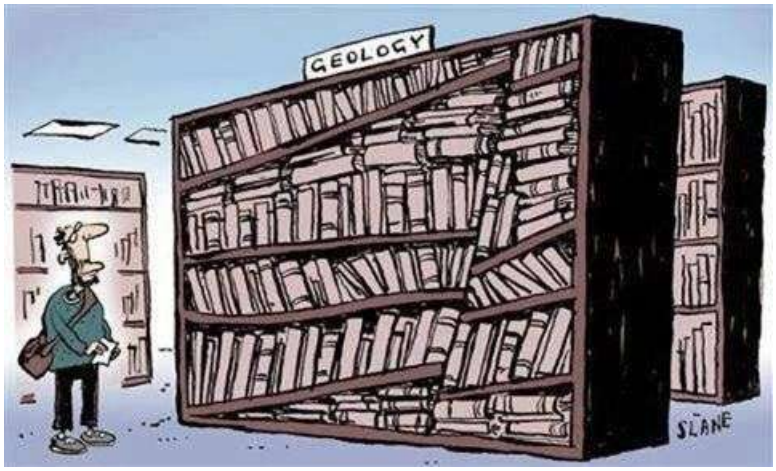
A light-hearted meander through the botanical byways of taxonomic Latin. Talk by Chris Metherell

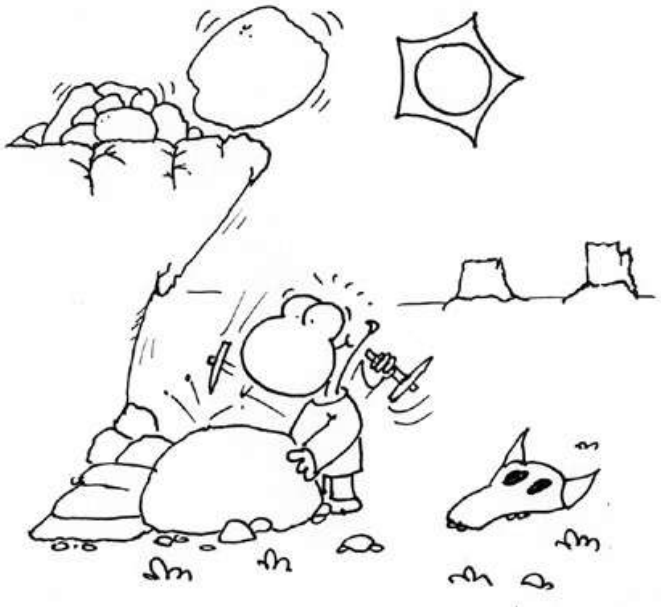
18th Mar 2016
Friday 18 March, 7pm-8pm
Great North Museum: Hancock

Latin names have been annoying laymen and scientists alike since well before Linnaeus in the 18th century. Why is the Oxford Ragwort called Senecio squalidus - 'dirty old man'? Why is there a beetle called Agra katewinsletae, not to mention a genus of fish called Batman. Why do zoologists like repeating themselves with names such as Gorilla gorilla gorilla? (no prizes for guessing the English name). Chris will throw a light-hearted spotlight into the dusty corners of scientific Latin (mainly botanical) and promises that there will be no test at the end! No need to polish your declensions or buff up your gerundives for this end of term amusement.

Chris is botanical recorder for vice-county 68 (North Northumberland), and is Honorary General Secretary of the Botanical Society of Britain and Ireland.

GEOVIAL GEOLLITY





The geologist Peter Stoned, absorbed and blinded by the excitement, is on the point of reaching his final scientific fate by hitting a rock from a very interesting Devonian outcrop.

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