

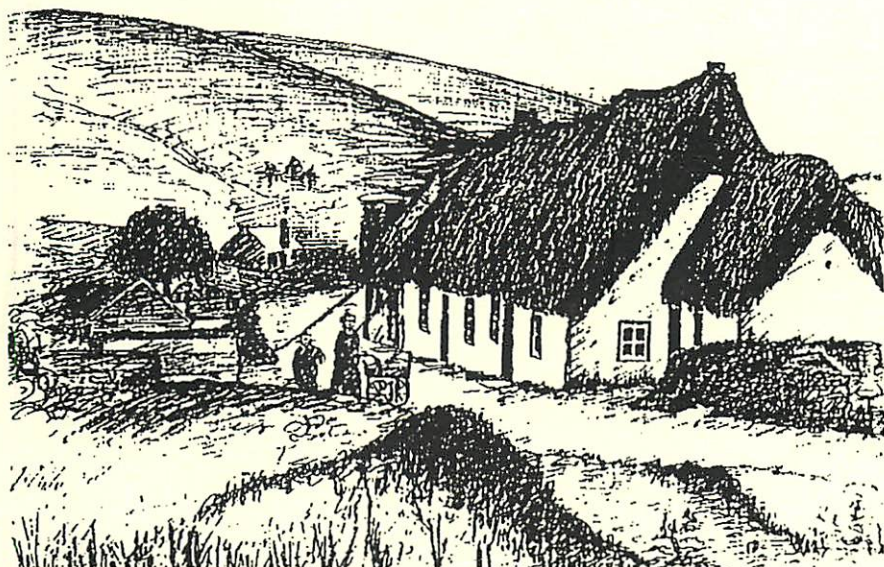
# **The Edinburgh Geologist**

**Magazine of the Edinburgh Geological Society**

**Issue No. 35**

**Autumn 2000**

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**Incorporating the Listing of Books held  
in the Library of the Edinburgh Geological Society**

# **THE EDINBURGH GEOLOGIST**

Issue No. 35 Autumn 2000

## **Cover Illustration**

The cover shows an drawing of Wanlockhead in the nineteenth century and relates to the article on the Museum of Lead Mining on page 15 of this issue of THE EDINBURGH GEOLOGIST.

The illustration is published with kind permission of the Wanlockhead Museum Trust.

## **Acknowledgements**

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## Editorial

by Alan Fyfe



Welcome to this edition of The Edinburgh Geologist, the last of the Millennium. For those still confused about this, I have written a short explanation at the end of this editorial, seeking to explain latest developments in millennial nomenclature.

You may think that this is a rather slimmer volume than usual. The most astute amongst you will realise why this is so. It is because of lack of copy. So if you find an editor chasing you to write something, please treat him kindly!

Contributors that have treated me kindly for this issue include some old favourites. First amongst these is Phil Stone, who has written an article on periglacial features in the Falkland Islands. When I first saw the title, I was a little unsure what it was about, but it is an interesting and entertaining read.

This is followed by a short article by Bill Coppock and Bob McIntosh on the Edinburgh Geological Society's Library. It is a prelude to the listing of all the library's holdings, which I have printed as an appendix. As you will read, Society membership means that you can apply to be a reader in the University Library, a privilege that is certainly worth the small effort of application.

In the series What's in a Name? I was sent, out of the blue, a contribution by Alyn Jones, who has been an Edinburgh Geological Society member since he graduated from the University here in 1953. He has written about the connection between Celtic tribes and geology. This was in answer to a plea of mine in the last issue and he admits that after he began his research into the subject, he learned a lot more about the Celts. He also admitted that it was easier to write than a geological paper!

We have a new feature, which I have called Geo-vineyards. It all stemmed from an interesting wine label sent to me by Cecilia Taylor. We have another one for you for the next issue as well!

Lastly, we have a few words on the Wanlockhead Museum of Lead Mining, contributed by Bob Reekie. The museum, like many small museums and galleries, is suffering from government funding now being generally restricted to national institutions. I hope that his contribution will encourage some of you to make Wanlockhead a weekend destination. As a postscript, I have included here a previously unpublished short piece that was prompted by teaching children the art of gold panning.

## Editorial

Well, not quite lastly, because this issue includes a series of reviews on the BGS's recent Earthwise publications on fossils. Five are reviewed here, and all are recommended by the reviewers. They are available from the Bookshop in Murchison House, at less than £10 for the set of five. This would make a fine Christmas present for a young fossil enthusiast or amateur geologist.

I am pleased to be able to publish in Poet's Corner a song by Alexander Rose, sent to me by David Land. And we have our now regular Rocksword Puzzle by Angela Anderson. Thanks to both of them.

Now to the millennium. It all started with A.D., which is *anno domini*, the year of Our Lord, the year that it was once calculated that Jesus Christ was born. That was year one. After that year was over came the second year of Our Lord, year 2 A.D. After 999 years were over came the 1000th year of Our Lord, year 1000 A.D. And so, by similar counting, this year, 2000 A.D., is the 1999th year since the year when Jesus Christ was born. This is why the new Millennium does not start until January 2001.

Of course, it is now believed that Jesus Christ was born in or around 3 B.C., which complicates the whole thing and means that A.D. is not the year of Our Lord after all! It also means that most of us missed the Second Christian Millennium... which is rather a pity! But to resolve this issue, so I was recently informed by a man of the cloth, it is better to use the letters C.E., meaning Common Era. After all, the current system is used world-wide, irrespective of religious belief, and a common era is what it has become.

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Copy date for the next issue of THE EDINBURGH GEOLOGIST  
Wednesday 28th February 2001

## Periglacial Princes Street - 52° South

by Phil Stone

Imagine yourself on Princes Street in February. A stiff westerly wind rattles the hail around your collar and there's not a bus in sight. That might sound a familiar situation to many members of the Edinburgh Geological Society but this particular Princes Street is about 8000 miles away in the Falkland Islands. The name was transplanted by an émigré Scot but, apart from the fact that both versions run east-west, it is quite hard to see what similarities provoked the association with home (55° 56' North). The southern Princes Street is actually an enormous periglacial boulder field, the largest of the famous Falklands 'stone runs'. These are more-or-less flat-topped spreads of large quartzite blocks that fill many of the valleys or blanket hillsides. The apparently uniform surface level belies the more local structure since many boulders are balanced precariously and gaping holes open out downwards, whence rises the sound of running water. In many places parallel, linear zones of boulders, up to 5 m across, and more than 100 m long in places, alternate with similar-sized strips of vegetated ground. Repeated scores of times across the hillside these produce a bizarre, striped landscape.

The boulder fields and stripes certainly impressed and puzzled all of the early scientific visitors to the islands. One such was Charles Darwin who, in 1845, wrote in the second and enlarged edition of his *Journal of Researches*:

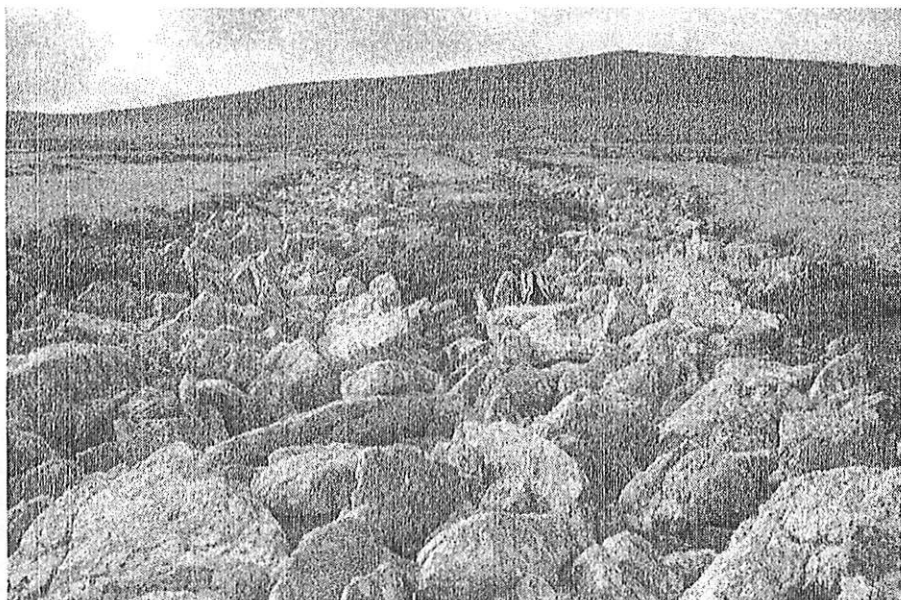
In many parts of the islands the bottoms of the valleys are covered in an extraordinary manner by myriads of great loose angular fragments of the quartz rock, forming 'streams of stones'. ... The blocks are not waterworn, their angles being only a little blunted; they vary in size from one or two feet in diameter to ten, or even more than twenty times as much. They are not thrown together into irregular piles, but are spread out into level sheets or great streams.

Darwin was probably describing the Princes Street boulder field when he wrote this. He certainly walked across it and a little later, after a visit to the Falklands by the 1901-1903 Swedish South Polar Expedition, Professor J. Andersson described it as the 'Darwin stone-river', although he also reported that "an old Scottish shepherd ... named with rustic humour this vast and almost impassable accumulation of millions of huge quartzite blocks Princes' Street". Plenty of Scots were certainly involved in the exploration and colonisation of that part of the world and many family names are remembered geographically, together with the possibly generic Mount Jock. Perhaps surprisingly, there are very few other examples of

## Periglacial Princes Street

transplanted Scottish place names, with Dunbar and Douglas about the only possible competitors for Princes Street.

Since the Darwin and Andersson accounts the vernacular term 'stone run' has been generally adopted to describe these distinctive Falklands features. However, no other stone run has managed to acquire its own unique name although the landform is pretty widespread and there are other sizeable examples. The stone runs occur across both of the main islands, West and East Falkland, and are principally associated with the outcrop of one particular rock type, quartzite. This occurs at two stratigraphical levels within the Port Stanley and Port Stephens formations. Falklands stratigraphy has only recently been formalised following a comprehensive survey programme carried out by the British Geological Survey on behalf of the Falkland Islands Government. The survey work was led by Don Aldiss, from BGS, assisted by Emma Edwards, a Falkland Islander and geology graduate; this article draws heavily on their work. Don and Emma established the Port Stanley Formation as the highest part of the largely Devonian West Falkland



*A typical development of stone stripes at the margin of a large boulder field. The ground slopes gently towards the viewer. A rucksack provides scale.*

## Periglacial Princes Street

**Group.** The Formation consists of pale grey, very hard quartzites with subordinate, softer siltstone and rare mudstone. At the bottom of the West Falkland Group, the Port Stephens Formation contains somewhat similar but rather more feldspathic quartzites and may range down into the Silurian. The Port Stanley Formation forms much of the high ground on East Falkland where it gives rise to the most extensive stone runs. At some 4 km long and up to 400 m wide, Princes Street is the largest of these and lies about 20 km north-west of the Falkland Islands' capital, Stanley.

The Falklands stone runs seem to be unique in terms of their variety, size and abundance but similar, more restricted examples are known from elsewhere in the World. Numerous theories have been proposed for their origin (Darwin put their formation down to earthquakes) but it is now generally accepted that the stone runs formed during the last Ice Age, about 26,000 to 13,500 years ago, as a result of intense frost action alternating with periods of thaw. During that time the Falklands were largely free of glaciers, with the exception of a few occupying small cirques on the highest hills, but the islands were subjected to a savage polar climate. Hence the stone runs are relict landforms, produced by mass-movement under periglacial conditions.

Many features are shared by all of the stone runs, regardless of their size, form or situation. They are almost entirely composed of locally-derived quartzite blocks. Most blocks seen at the surface are between 30 centimetres and two metres across, and rarely up to five metres long; the range of block size can vary locally, however. Some blocks in stone runs are equant, but most are tabular or elongate, their shape and size reflecting the common distribution of joints and bedding planes in nearby quartzite exposures. The blocks tend to be fairly angular, with only slightly rounded corners and little other sign of abrasion. In many stone runs the blocks are randomly arranged but some display a marked fabric in which the tabular blocks are packed together on edge. These blocks tend to be orientated parallel to the slope and are usually seen near the margins of a stone run. Excavations show that the largest boulders form the top part of the stone run with the size of the blocks then decreasing downwards. This attribute was utilised by the British troops advancing against the occupying Argentineans during the 1982 conflict. The soldiers realised that if a large block could be displaced from the top of a stone run, then the smaller cobbles underneath could be readily removed to create a commodious dug-out. This exercise was made easier by the absence of matrix material right down to the base of the stone run, where the basal blocks lie abruptly on unsorted regolith or, more rarely, on bedrock. Although boulders in the upper parts of undisturbed stone runs



## Periglacial Princes Street

are uniformly pale grey in colour, lower down in the stone run, where they have been in long-term contact with water but have otherwise been protected from the weather, the boulders and cobbles are invariably stained by iron oxides. This was the disadvantage of the stone-run dug-out; the piles of excavated orange-brown cobbles gave away its position!

During the recent mapping project in the Falkland Islands Don Aldiss had ample opportunity to study the stone runs and concluded that at least five processes were involved in their formation: weathering, solifluction, frost-heave, frost-sorting and washing. In addition to the hard, white quartzite, both the Port Stanley Formation and the Port Stephens Formation include feldspathic sandstones, with some siltstones and mudstones. These latter rock types would be readily broken down, by frost and chemical weathering, to sand and clay whereas the hard quartzite would survive as large boulders. As this unconsolidated mixture was subjected to repeated freezing and thawing it would gradually creep downhill, a process known as solifluction. At the same time, frost heave would tend to move the quartzite blocks towards the surface of the deposit, and frost-sorting would cause them to be grouped together. On level ground, frost-sorting can give rise to polygonal patterns but even on the slightest slope these become elongated and pass into stripes. The width of the stripes generally increases with clast size and so the availability of abundant large boulders was probably crucial for development of the exceptionally large Falklands examples. Between the stripes and beyond the limits of the boulder fields isolated blocks lie in a heterogeneous mixture of clay, sand and angular pebbles. There is barely any gradation between the two deposit types, nor is there any difference in their surface levels beyond that created by the vegetation cover over unsorted ground.

The complete removal of matrix from the stone runs is the outstanding enigma of their formation. Much of it was probably washed out progressively by rain or by streams flowing within the stone run, but Don Aldiss considers that the earlier, gradual replacement of the clay-rich matrix by ice also played a part. He points out that rock tends to have a higher thermal conductivity and a lower heat capacity than an adjacent moist, fine-grained matrix. So, as the ground freezes, the freezing front will advance more rapidly through the blocks than the matrix. Ice formed under these conditions around the blocks will effectively push away the fine-grained matrix and the smaller stones. The combination of repeated freeze-sorting and washing during periods of thaw eventually generated ice-bound concentrations of large blocks; these became the stone runs. As the climate became milder the intervening areas still underlain by the heterogeneous, clay-rich, solifluction



regolith were preferentially colonised by plants. In this way the vegetation now accentuates very effectively the patterns originally produced during the Ice Age.

Finally, some corrective action is necessary. The first two sentences of this article might have given the impression that summer in the Falkland Islands leaves something to be desired. The odd hail squall straight from the Antarctic is certainly a possibility but, in general, Falklands weather has received an unjustifiably bad press. It all started with Darwin who wrote of “miserable islands ... with a desolate and wretched aspect”, but anyone familiar with summer in the Hebrides would feel quite at home, though the Falklands are drier and windier. They also have one other attribute to gladden the heart of any Scottish field geologist – nae midges! What’s more, Princes Street - 52° South, has no bus lanes, traffic wardens, burger bars, Big Issue vendors...

**For more information on the Falkland Islands stone runs you could try:**

Aldiss, D.T. & Edwards, E.J. 1999. *The geology of the Falkland Islands*, British Geological Survey Technical Report WC/10/99, pp. 97-103.

Clark, R., Edwards, E., Luxton, S., Shipp, T. & Wilson, P. 1995. Geology in the Falkland Islands, *Geology Today*, Volume 11, pp. 217-223.

Rosenbaum, M. 1996. Stone runs in the Falkland Islands, *Geology Today*, Volume 12, pp. 151-154.

The new 1:250 000 solid geology map for the Falkland Islands (on two sheets) is available through the British Geological Survey or from the Department of Mineral Resources, Ross Road, Stanley, Falkland Islands. Price £20. Highly recommended.

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Phil Stone works with the British Geological Survey at Murchison House. He is mostly concerned with the rocks of southern Scotland and northern England but also acts as geological advisor to the Falkland Islands Government’s Department of Mineral Resources.

## **The Edinburgh Geological Society Library**

**What is it? Where is it? How do I join?**

**by Bill Coppock and Bob McIntosh**

Did you know that the Edinburgh Geological Society has a library of periodicals and about two hundred books, ranging from *Moon, Mars and Meteorites* by Peter Adams to *Dinosaurs from China* by Dong Zhiming? The books have been purchased over the years, selected for their accessibility and interest to the membership and can be borrowed with the minimum of formality from their current location in the University of Edinburgh, Grant Institute of Geology.

Our books and serials are managed by the University Library, and are accessible by holders of a University Library card. As a member of the EGS you are entitled to join the University Library, and you must do this in order to borrow EGS books. The positive aspect of this is that it is free! Furthermore it entitles you to full use of the University Library, a privilege which would otherwise cost a lay person a considerable fee.

### **How to join: a simple two-stage process**

Obtain proof of membership of the Edinburgh Geological Society - e.g. a letter from the EGS Librarian or other Library Committee member (details opposite).

Visit any Edinburgh University Library and ask to join saying you are a member of the Edinburgh Geological Society and offer the above proof of membership.

This membership entitles you to use and borrow books from Edinburgh University Library as well as from the Edinburgh Geological Society Library but remember, you will need to show your Edinburgh University Library membership card whenever you borrow books - even from the Edinburgh Geological Society Library.

### **Recent and future developments**

At the end of last year, we started bringing a selection of the books to the coffee session after the evening lectures for browsing by members. This was so successful that we will definitely be continuing this service during the new 2000-2001 lecture season. Also, at these sessions you can have your application form for Edinburgh University Library signed on the spot by a Library Committee member, you can

## **The EGS Library**

borrow books (on production of the EUL membership card) and return books as well as peruse or take away a full list of EGS books.

The Library Committee will also be selecting new books on geology for purchase. If any members have read an exciting book, or seen details of a book they would like to recommend for purchase, or even have views on the types of books they would like to see in the Library, please contact a Committee member - after a lecture or using the details below.

### **Contact details**

**Bob McIntosh**  
**EGS Librarian**  
**c/o British Geological Survey**  
**Murchison House**  
**West Mains Road**  
**Edinburgh**  
**EH9 3LA**

**Telephone:** 0131 650 0239  
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**Bill Coppock**  
**EGS Library Committee Member**  
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**Edinburgh**  
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**Telephone:** 0131 667 6872  
**E-mail:**        [bill.coppock@wildbay.freemove.co.uk](mailto:bill.coppock@wildbay.freemove.co.uk)

The listing of the Society's holdings is given on page 29.

# What's in a Name?

*In the final paragraph of my Editorial in the Spring issue of The Edinburgh Geologist, I asked whether anyone knew anything about the Ancient British tribes, the Ordovices and the Silures. In response to this, I was sent the following contribution by Afyn Jones of Ashby de la Zouch.*

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## Celtic Connections

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The *Ordovices* and the *Silures*, which gave their name to the geological ages Ordovician and Silurian, were Celtic tribes living in western Britain at about the time of the Roman conquest in 43 CE. The *Ordovices* occupied most of northern Wales from about Aberystwyth in the west to near Shrewsbury and the Long Mynd, while the *Silures* inhabited southeastern Wales from present-day Llanelli to Newport.

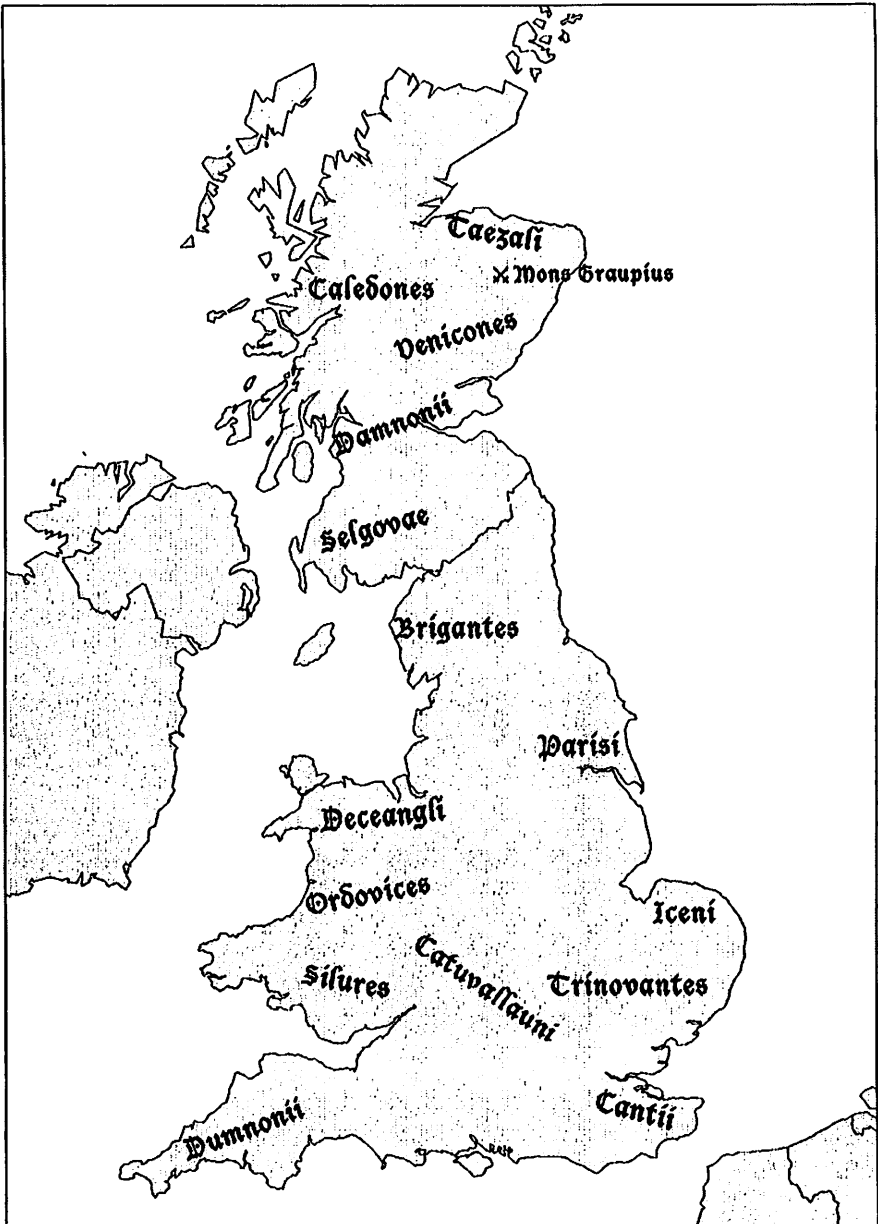
In 51 CE, Caractacus took the warlike *Silures* north to join the *Ordovices* and was defeated by the Romans. The *Ordovices* were reputedly annihilated ten years later by the Roman general Seutonius Paulinus in order to safeguard the Roman Province from their depredations.

The name *Ordovician* was first used by Charles Lapworth in 1887 and *Silurian* by Roderick Murchison in 1835.

Two, or possibly three, other Celtic tribal names from this same period have been used in British geology, leading to the Brigantian, the Caledonian and, by a slightly more circuitous route, the Devonian. The *Brigantes* occupied the valleys of the Pennines and the north-west of England and much of Yorkshire, south to Cheshire and north into southern Scotland.

The *Caledones* were located a little to the north of Perth in the upper Tay valley with Schiehallion, which takes its name from the Gaelic *sithean Chailleann*, the fairy hill of the Caledonians, as their sacred mountain. The *Caledones* were defeated, with their allies the Picts, by Agricola at the battle of *Mons Graupius* in 84 CE. The site of the battle is now believed to be near Bennachie, west of Inverurie. As a somewhat bizarre aside, the sixteenth century historian Hector Boece misread the name *Mons Graupius* as *Mons Grampius* and thus gave the name to the Grampian mountains. They have in turn given their name to the Grampian orogeny, a mountain-building event of around 470 Ma.

## *What's in a Name?*



*Tribes in Celtic Britain during the First Century BC (after Delaney, 1986)*

## *What's in a Name?*

The name *Brigantian* was given to a Stage in the Visean (Carboniferous) by Ramsbottom and Mitchell in 1980. Description of the Caledonians goes back to 1656, but its use in geological literature is of the early Nineteenth Century. The name of Devon is thought to have been derived from the *Dumnonii*, who occupied that part of the country.

This all rather begs the question as to who were all these Celtic tribes and where did they come from? There is an immense amount of literature about and by them going back to 500 BC but it is only in the last thirty years or so that a clearer picture has emerged. The Celts left almost no written records before about 500 CE, and it is reports from Greek and Roman writers that give the earliest information, together with that from archaeology. It is the Roman names that appear on the map on page 13.

The origins of the Celtic peoples are uncertain but they appear to have started to migrate from eastern Europe around 2000 BC and spread across western Europe including Italy and the Iberian Peninsula, France and the Low Countries before arriving in the British Isles about 700 BC at the beginning of the Early Iron Age. There were further incursions from France and the Low Countries in the early part of the fifth century BC, mainly into south-east England. Britain had been inhabited from the Bronze age or earlier going back to at least 2000 BC but it is not clear whether the Celts displaced this earlier population or simply colonised them. The Celts were never a unified kingdom but remained a tribal people with a more or less common language base.

Once established in Britain, Celtic society was temporarily disrupted in southern England by Caesar's raids of 55 and 54 BC but continued to flourish for nearly a century with increasing influence from the Roman world. During the Roman period, especially in southern Britain, it subtly metamorphosed into a Romano-Celtic (usually referred to as Romano-British) culture, in which some of the most outstanding achievements were in art. This Romanisation continued until 409 CE when the Legions were withdrawn and the invasions of several different groups began.

Scotland by this time was ruled by several Pictish kings but in the early 500s CE in the west of Scotland, the Scots, a Celtic tribe from northeastern Ireland occupied Argyll while the by-then North and South Picts moved into Cumbria and the German Anglo-Saxons invaded eastern England. It is believed that these last were in quite small numbers but their influence eventually led to their dominance. The

## *What's in a Name?*

purser Celts remained on the edges in Cornwall, Brittany, Wales, the Isle of Man, Ireland and Scotland where they continued their tribal life until around 1200 CE. The last remnants are still with us in the clans of Scotland and Ireland though much muted since 1745.

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After graduating from Edinburgh University and joining the Edinburgh Geological Society in 1953, Alyn Jones went into the mining industry as a geologist. Metal mining was first at Wanlockhead, followed by coal mining in the West Midlands, Warwickshire, Leicestershire, Kent, North Wales, Lancashire and Cumberland. He took early retirement in 1985 but did a little work in India after this.

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### CORRECTION

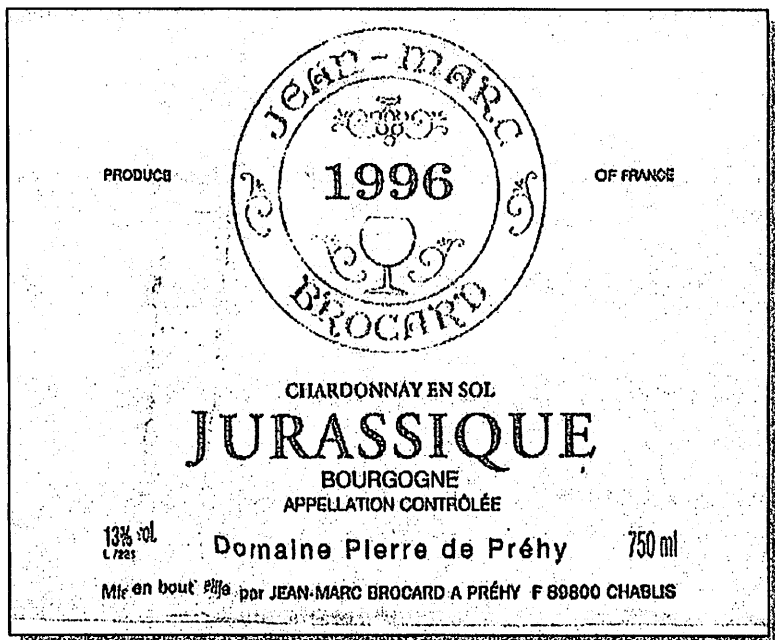
In the last issue of THE EDINBURGH GEOLOGIST, *What's in a Name?* contained a historical error. The Margaret of Scotland that is buried in the chapel at Thouars was not Malcolm Canmore's queen at all, but a daughter of James I, who married the dauphin Louis. She died young in 1444, before he became king as Louis XI.

I am grateful to member Dorothy Forrester for writing to me with this correction .

Editor



# Geo-vineyards



## Tasting Notes

This wine comes from an ancient vineyard that once benefited from an epicontinental palaeoclimate. It is packed full of ripe tropical fruit flavours, which is hardly surprising as during the Jurassic, the Chablis region was somewhere near the Tropic of Cancer. Its inferior oolitic nose does not do justice to the huge soft estuarine finish, largely provoked by a pinch and swell structural regime. It is drinking well now, though not as well as some Triassic wines from vineyards to the east and could well do with laying down for at least another era. If you are tempted to try it now, its mature notes make it ideal for drinking with roast pterodactyl or Ichthyosaur.

Thanks to Cecilia Taylor for finding and sending me the wine label, though she should not be held responsible for the Tasting Notes. Does anybody else have any similar trivia brought back from their holidays?

## Wanlockhead Museum of Lead Mining

by the Editor with contributions from Bob Reekie

Scotland's Museum of Lead Mining at Wanlockhead is in trouble. Financial trouble. As with many small museums in the provinces, it has suffered from a cutback in funding by the local council. I spoke to Bob Reekie, who says, "to be fair, Dumfries and Galloway Council have been very supportive but they have had their funding cut and something has to go." He says that if they cannot secure support from central government, we could be in danger of losing part of the people's heritage in Scotland.

I suggested to Bob that he could write me something and he has promised to send me an article on the history of mining at Wanlockhead for the Spring issue, when the Museum opens again for the year. Maybe this will encourage some Society Members to take a day out to Leadhills and Wanlockhead. The more visitors that pass through the door, the better, as far as the future of the museum goes. He was able to give me a couple of letters from some of this year's satisfied customers. Maybe it will give you something to think on.

The first is from a gentleman from St. Ives, keen to compare Wanlockhead with the Tin Mines in Cornwall.

My visit to Wanlockhead was one I very much enjoyed and I am most impressed in the quality and variety of your exhibits in the Museum and the underground trip gave me a very good idea of past mining conditions. Actually similar to those in Cornwall, either cold and wet or, in the deeper, poorly ventilated ones, hot and wet!

Your miners' cottages were, I thought, superb and I am well aware that we down in Cornwall lack this aspect of mining history. One which we must try and improve on.

Wanlockhead is a most nostalgic place and I shall do my best to encourage more people to visit the area when I meet them here.

Charles Smith

## Wanlockhead Museum

The second is from a more junior visitor. She had produced her notes in the form of a publicity brochure. Unfortunately, I cannot reproduce all her colourful drawings as well.

To start this great day go and visit the museum. A Factual life like experience. Understanding the mine. Seeing minerals and testing their strength.

See the wonderful cottages for a feel of how life would have been in 1740 and 1890. Go and have a look at our old chemist shop and to top the cottages off you'll have a guide to take you round.

Next go and see one of the most adventurous events of the day the mine. Get a feel of how the mine would be with just candle lights. Safety helmets provided and a guide to improve your history.

Have a chance to be a geologist. take your family on the spoil heaps. Collect minerals and rocks. Anything you find you can keep.

Go panning for gold down in the stream. Visit the library and graveyard. Take your children to the park and take them paddeling in the stream.

Megan Bailey

Lead was mined on a commercial basis from the start of the eighteenth century until 1958. One of the highlights of a visit to Wanlockhead is to take a tour of the Loch Nell Mine and to see and hear how the miners worked underground. Silver was found in conjunction with the lead and was separated using a variety of techniques. Gold recovered from the streams around the village was used in the making of the Scottish regalia and to embellish the mace for the Scottish Parliament. Visitors to the Centre have the opportunity to take a lesson in gold panning. This year, there were Gold Panning Championships in May.

## Wanlockhead Museum

While the Championships were on, your Editor was showing a group of Cub Scouts how to pan for gold (using fool's gold of course). Like all youngsters, they were keen for the hands-on experience. My commentary went something like this:

"Take hold of the pan in both hands. Keep those ridges away from you. No, turn it round. Move your hands. Give it to me. Hold it like this, with one hand on each side and with the ridges away from you. Good.

"Now - you see the sand and gravel. Swirl the water round and get it all moving. Try to use a circular motion. Not quite right. I'll show you. Leave go. Try it like this: you see how the water is swirling around and taking the sediment with it. Now you try it. No - use both hands and have the ridges... that's right.

"Okay - swirl it around. That's good. Keep going. That's fine. Now slowly tip the pan away from you so that the sand and the gravel spill over the... **Don't stop swirling!** You have to do both at the same time. Watch me.

"There - I swirl round and round and you see how the water picks up the sand and gravel. I keep that going and tip over the far edge. You see how all the sand spills out. And here in the bottom, beneath the sand that remains is the gold. It stays behind because it is heavier.

"No it isn't real gold - it's fool's gold. Now you try. No - don't pick it out yet. You must keep on panning. There's no way to cheat nature.

"Fine. That's a good swirling motion, but what about the ridges? Where are they? Start again. That's better. Keep it going. Now spill it over the edge. That's good.

"No... leave it alone. Put a bit more water in and try again. Swirl around. Good. Now tip it out. Don't be frightened - you won't lose the gold. Good - now a bit more water and keep going. You have to keep this up again and again.

"Yes, the gold's still there. Look. No - leave it alone and continue panning. Now you have more of the gravel, so you have to swirl a little faster. And tip... good. Now you can see beneath the ridges... no... leave it alone.

"Okay. You can take that away. Who else wants a go?"



# Poet's Corner



Song  
by Alexander Rose  
Tune — 'Maggie Lauder'

*Yestreen I heer'd a lectre on  
Geology they ca'd it,  
It coost a shillin hale; Ochon!  
I sairly was defraudit.  
It was pang fu' o' senseless stuff,  
An' words as lang's a cable;—  
There's nae been spak sae muckle buff  
Sin' the days o' ancient Babel.*

*The speaker was a cracky loon,  
And muckle did he blether;  
His gruesome names o' fearfu' soun'  
Gart my hair stan' up like heather.  
He said the yirth was made o' stanes—  
(We a' kend that afore him),  
That fire an' water feucht at ance  
And rais'd the hill Cairngorum.*

*Wi' pictres war the wa's stuck fu'  
O' beasts like fierce Hobgoblins;  
Their e'en as wide as bannets blue,  
Glour'd roun' wi' fearfu' oglins.  
On the table war as mony stanes  
Might ser a callants bicker;  
An' rotten trees and kirkyard banes,  
That look'd nae very sicker*

## Poet's Corner

*The speaker had a rod in's hand,  
An' wagged it like a warlock;  
Whan he touch'd a beast the smell I fand  
O' brimstone or o' garlick;  
Wi' whipsaw teeth war sets its jaws,  
Just open for devourin;—  
As big as cleckin' boards its paws;  
Its e'en war red and glourin.*

*The globe, he said, a sair wame took,  
An' then it burst asunder,  
An' hills an' bens thegither shook  
And fell wi' noise like thunder.  
Fear gar'd my e'en wi' glaumer glour,  
I thought the house was shakin;  
My hert gae sugh — I bang'd out oure,  
For I tru'd the roof was brakin.*

*My lodgin' was a public house  
And hame I ran fu' sairly;—  
I ca'd for drink to mak me crouse,  
Then gaed to bed fu' early,  
I fell asleep but was na lang  
Left to enjoy my snorin—  
For I dreamt the brutes upon me sprang  
An' made a dreedfu' roarin.*

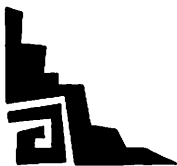
*I waken'd, whan I heer'd a croon,  
An' couthly was it liltit,  
"The Laird o' Cockpen" was the tune,  
King Charlie's heart that meltit.*

## Poet's Corner

*An' sine a rumlin noise gat up,  
An' clappin' hands an' skirlin',  
I thought the vera bed wad coup,  
For a' the floor was dirlin'.*

*I rang, an' ca'd the Landlord ben,  
An' speer'd what was the matter;  
He said it was some bedlam men  
That made an unco clatter:—  
They were a gang o' queerish chaps,  
A' arm'd wi' bags an' hammers,  
That to the rocks gae fearfu' raps,  
An' bor'd them through wi' rammers.*

*But the daftest man o' a' that crew,  
Is R—— that gies the lectres;  
He gars them true that stanes are fu'  
O' beasts like grissly spectres.  
They're frae a lectre come, I think,  
A' in their Sunday dresses,  
To sing an' roar, an' eat an' drink,  
An' fill dead fu' their Preses.*



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The above poem was written by Alexander Rose and published in Mrs. Rose's biography. It was provided for publication in this magazine by David Land who has tried in vain to trace the copyright holder. Mrs. Rose died a few years after her book was published and the publishers are no longer in business. The Society trusts that it will be excused any inadvertent breach of copyright in quoting from this book.



# BOOK REVIEWS

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*We have no less than five reviews this issue, all BGS publications. They each form part of the **Fossil Focus** series and are available from the Book Shop in Murchison House. They all take the form of a two-sided A3 laminated card folded in triptych style, described by one reviewer as not unlike a motorway services menu but offering a more tempting read. Another reviewer points out that it can be propped open allowing complete scanning of the interior with freedom to take notes if desired. All reviewers congratulate the clear text and colourful graphics.*

*The reviewers are all amateurs, past students of the University of Edinburgh's Open Studies course, aptly named **Fossils in Focus**. The reviews are followed by some of their comments on the course.*

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## FOSSIL FOCUS — BIVALVES

Angus Macpherson

The BGS continues to maintain its high standard of publications with this leaflet on Bivalves, one of a series of five on fossils intended for the amateur geologist. The leaflet is beautifully produced and illustrated in full colour. There is a fine painting by Richard Bell of a seascape showing bivalve environments and conveying much information very attractively. The same can be said of the text, which is a model of accurate, concise and elegant writing, uncluttered by technical expressions. The author, Mark Woods, is to be congratulated on his skilful presentation.

The first part, ***Bivalves: the animal***, describes the anatomy of the bivalve shell, including the function and significance of its component parts. The shape of the shell is related to the animal's way of life in its particular environment, whether it burrows into the sea bed with its muscular foot, or dwells on the surface where a strong, thick shell is needed to protect against predators. The anatomy of the soft, internal tissue relates to methods of feeding and locomotion, but these tissues are missing from fossil bivalves.

The second part, ***Bivalves: the geologists' tool***, shows how fossil bivalves can provide valuable information about the ancient environments in which they lived and, in places, a guide to the age of the rocks in which they are found. There are useful summaries of such terms as 'correlation', 'biostratigraphy', 'faunal provincialism' and 'biozones', together with a geological column and a map of the main areas of sedimentary rocks in Britain from the Cambrian to the Recent.

## BOOK REVIEWS

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The final part, *Bivalves: folklore and fact*, recounts some unusual information about bivalves and should whet the reader's interest to pursue the subject in a more advanced text such as Peter Doyle's *Understanding Fossils* or Euan Clarkson's *Invertebrate Palaeontology and Evolution*.

### FOSSIL FOCUS — BIVALVES

Mark Woods

BGS Earthwise Publications, £1.95

ISBN 0 85272 328 8

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### FOSSIL FOCUS — FISH

Terri Cunningham

This BGS leaflet is a delightful introduction to the evolution of fish. It is clearly written and lavishly illustrated with explanatory diagrams, paintings and photographs of actual fossils. The concise text explains the evolution of the main groups of fish, beginning with the early Cambrian jawless fish. Fossils of this group are rare because they were boneless. The development of jaws was a major stage in fish evolution and the two main groups of jawed fish, those with cartilaginous skeletons and those with bony skeletons, are described.

The leaflet then looks at the lobe-finned fish including the coelacanths, thought to be extinct until a discovery made in the Indian Ocean in 1938. The ray-finned fish, named for having bony rays supporting their fins are next explained; most of today's fish types fall into this latter category. Although the origin of fish is obscure, the leaflet suggests it may be found in invertebrates, and that the nearest ancestor may have been the chordate, *Pikaia*.

An illustration spanning the interior shows an artist's impression of the fish types through time. Fish from the Silurian, Devonian, Jurassic, Cretaceous and Palaeogene are illustrated. On the back, an evolutionary tree clearly illustrates the timelines of the main groups of fish. The names of all the fish illustrated or mentioned in the text are printed in their appropriate positions showing their relative ages.

Finally, the section called *Fishy tales* gives an historical perspective and some interesting anecdotes on aspects of fish fossils, including 'tongue stones' chronicled by Pliny the Elder, Shakespeare's 'toad stones', and the discovery of the living fossils, the coelacanths.

## BOOK REVIEWS

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As fish now 'form over half of all living vertebrates', this leaflet can only be a brief introduction to the subject but, for all that, it is informative and would make a beautiful gift for the young or beginning palaeontologist.

### **FOSSIL FOCUS — FISH**

**Ian Wilkinson and Sally Young**

**BGS Earthwise Publications, £1.95**

**ISBN 0 85272 350 4**

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### **FOSSIL FOCUS — CORALS**

**Alec Ferguson**

The publication opens with a brief outline of a coral life cycle, serving to demonstrate the difference between the corals and the other coelenterata, followed by a generalised description, clearly illustrated by a diagram, of coral structure.

Each of the three main coral groups that are found as fossils is allotted to a short paragraph accompanied by examples in the form of colour prints along with a modern example for comparison.

The environment in which corals are found is dealt with and a more extensive section is devoted to coral reefs, including clearly illustrated version of the classic Darwinian account of the evolution of a coral atoll.

The distribution of corals through geological time and their limited use in biostratigraphy, confined to the Lower Carboniferous, is neatly covered with the use of two straightforward diagrams. The intriguing use of corals in a similar way to that made of tree rings but at a scale of days rather than seasons to demonstrate celestial mechanics is a lovely touch as is the piece on the historical interpretation of coral fossils. To round off the work, the possible origins of the corals is considered.

The publication is clearly designed as a 'taster' to kindle an interest for corals in the amateur or young geologist and, in my opinion, this aim should easily be achieved. The only quibble, and it is a minor one, would be on the lack of a short list of suggested titles for further reading.

### **FOSSIL FOCUS — CORALS**

**Ian Wilkinson and Colin Scrutton**

**BGS Earthwise Publications, £1.95**

**ISBN 0 85272 349 0**

## BOOK REVIEWS

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### FOSSIL FOCUS — TRILOBITES

Eileen O'Rourke

On opening the card, the first paragraph is a useful brief summary of what a fossil is and the importance and time span of trilobites, information that is elaborated on later. This is followed by several photographs of fossils spread over the three interior card sections. Five different specimens are depicted, from the tiny agnostid to the very large, though incomplete sample of *Paradoxides*.

Three pale green highlighted blocks hold further details. The first contains the meaning of the more general geological terms, such as 'ecological niche' and 'bedding plane'. The second gives the derivation of the name *trilobite*, and the third, an explanation of certain key words.

Coverage of the various parts of the animal is very good, what they are, along with the scientific name picked out in black lettering. The divisions of the exoskeleton are named, its use, and why fragments are often all that can be found, soft parts being a rarity. A simplified coloured drawing of a 'basic' trilobite exoskeleton is supplied with the named parts. This is very useful for the interested student, considering the difficulty in deciphering incomplete fossils when found in the field.

Two of the five trilobite specimens are shown in the middle card section, one with large eyes and one blind. The different types and structure of eyes indicates the diversity of creatures' lifestyles. A detailed painting of trilobite lifestyles in different geological periods is a nice touch. It shows various types of trilobite amongst other fauna, depending upon period and sea depth. The names of the other fauna are given and although one's observation is restricted by the unavoidable reduction of size for the publication, a magnifying glass enhanced the details, rather important if one wishes to interpret a *Cruziana* trail, perhaps all that is seen on a field trip.

Since mention is made of the ability of various trilobites to swim, crawl, burrow and/or walk, it would have helped to have an example of functional morphology, for example a reconstruction of the side view of a species of trilobite supported on its long genal spines, as with a particular genus of the Olenid trilobites. An example of similar spines is shown on the largest of the trilobites in the lifestyle painting, though these lie horizontally. Such a drawing would have fitted very well just above that of the exoskeleton, instead of the two coiled fossils. But that is just a personal desire and the only addition I would wish to make.

## BOOK REVIEWS

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The fourth section of the card expands on the first short summary. A geological era and period table makes clear the existence in time of trilobites and their usefulness in relative dating and stratigraphical correlation of sedimentary rocks. Evidence of environmental indicators is also stated, as is their use in the reconstruction of previous placement of land masses. A chart of the Iapetus Ocean with 500 million years ago land areas is supplied at the bottom of this fourth card section.

The back of the folded card is illustrated with colourful, amusing sketches, showing how strongly associated fossils of trilobites were, and are, with our human lives, in the historical, cultural, and even legendary sense.

The whole publication is very easy to handle, appealing and interesting to view, and with considerable information and visual delights filling a comparatively small area. Any interested amateur palaeontologist or undecided student of the like could well find inspiration to become involved in a deeper study of this subject.

### **FOSSIL FOCUS — TRILOBITES**

**Stewart Molyneux**

**BGS Earthwise Publications, £1.95**

**ISBN 0 85272 338 5**

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### **FOSSIL FOCUS — BRACHIOPODS**

**Elizabeth McLuckie**

As a newcomer to BGS booklets I am favourably impressed with this example and am encouraged to seek out others. The text is illustrated throughout with colour photographs, line drawings and schematics of brachiopods, with supporting graphics. This is an excellent booklet providing a first class introduction to the subject and I would highly recommend it.

The content is presented in three sections. *Brachiopods: the animal* takes up the first two panels and begins by summarising the long history of brachiopods (at least 550 million years) which were at their most abundant during the Palaeozoic era and have descendants surviving to the present day, though these are comparatively rare. A detailed description of the physical characteristics and habitat of the animal follows and includes superb line drawings of a typical brachiopod shell and a cutaway schematic of the workings of the internal organs. The largest illustration is an annotated Silurian seascape from a painting by Richard Bell showing how different species of brachiopods would have lived on the sea bed, both in shallow and deeper waters, and the fauna with which they would have shared the habitat.

## BOOK REVIEWS

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Specific terms, in this and in the second section, are printed in bold type and a glossary is provided either within the text, with the illustrations or in green highlighted boxes.

*Brachiopods: the geologists' tool* covers the next two panels and describes the variety of ways in which brachiopods aid geologists in the study of evolutionary processes as well as in palaeoecology and palaeobiogeography. Their value as stratigraphical indicators and as a tool for the correlation of sedimentary rocks is explained as being due to the fact that certain lineages evolved comparatively rapidly. This enables the relative ages of the rock strata from the Palaeozoic era, when the phylum achieved maximum diversity, to be easily identified to at least the level of period such as Ordovician and Silurian. More skill is required for rocks of the Mesozoic and Cenozoic eras because by then the phylum was less morphologically diverse and relatively rare.

The relative diversity of the phylum through time is amply illustrated by perhaps the most striking graphic in the booklet. At first glance it looks like a coloured spinning top or spindle but turns out to be a modification of the familiar geological column with a different colour for each period, the layers gradually varying in width to represent diversity, reaching a maximum in the Devonian period. The colours correspond to an adjacent map of sedimentary rocks in Britain to considerable effect. Photographs of fossils of typical species found in rock strata from different periods complete the section.

*Brachiopods: folklore and fact* on the last panel is devoted to discussing the fanciful names or descriptions which different kinds of fossil brachiopods have conjured out of people's imaginations, ranging from butterflies to birds and even old prison uniform arrows, with photographs of the fossils which have given rise to them. A sketch of a Roman oil lamp indicates why brachiopods such as *Terebratula* are also known as lamp shells. Coming right up to date, there is a colour photograph of a colony of the living brachiopod genus *Lingula*. The Chinese evidently prize it as a culinary delicacy and call it the sea-bean sprout.

### FOSSIL FOCUS — BRACHIOPODS

Beris Cox and Ian Penn

BGS Earthwise Publications, £1.95

ISBN 0 85272 346 6

## BOOK REVIEWS

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*I asked the five reviewers to tell me something about the course **Fossils in Focus** run by Edinburgh University's Centre for Continuing Education (CCE). I had not anticipated the warmth of the response that I received. The following snippets aim to give an impression of the comments. Cecilia Taylor tells me that the CCE plans to repeat the course in January 2001. Anyone who is interested in enrolling should contact the Centre for Continuing Education, 11 Buccleuch Place, Edinburgh (telephone 0131-650 4400). Full details of the course content may be obtained by writing directly to Cecilia Taylor, Department of Geology and Geophysics, University of Edinburgh, Kings Buildings, West Mains Road, Edinburgh EH9 7JW.*

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To read and study photographs and diagrams of fossils is useful and interesting, but quite pallid compared with a 'hands-on' study course such as supplied by Cecilia Taylor at the University of Edinburgh, Kings Buildings...

The *Fossils in Focus* course was a very good introduction to the study of invertebrate fossils... highly instructive... most enjoyable... invigorated by an enthusiastic tutor...

It was well planned and presented, with clear goals for the course and for each week's study... being more about how fossils are interpreted and used by the professional and academic rather than just a run through the taxonomy...

Each week there was a chance to get our hands on real fossils, use microscopes and get a feel for the work of real palaeontologists... to view through a good microscope is something not easily come by, except in an academic environment...

Clearly a lot of work went into the preparation of this course and... Cecilia's admirable teaching and her enthusiasm for the subject which made it come alive for her students... a fascinating insight into a vanished world of wonderfully structured creatures...

...the course was extremely enjoyable and enlightening and most definitely to be recommended.

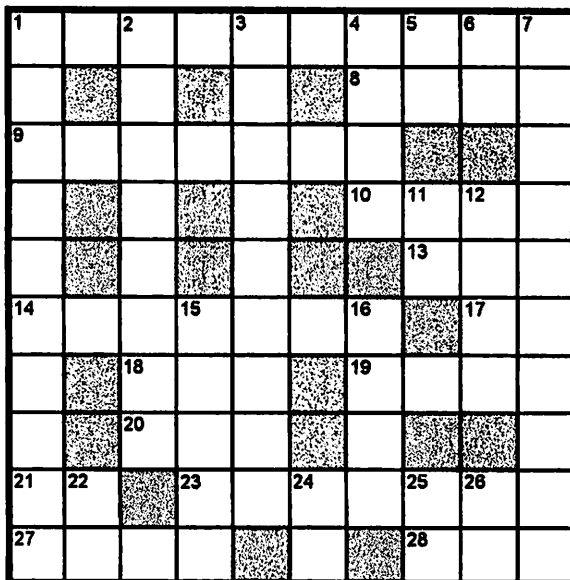




# **ROCKWORD PUZZLE No. 4**

## Clues across

1. A fishing hole in Caithness (10 letters)
8. Teas up where the sun rises (4)
9. Still it enters a glacial deposit (6)
10. Leave no empty spaces (4)
13. By way of (3)
14. Trainee sandstone (7)
17. Short for example (2)
18. In negative notation (3)
19. Winter may begin in school time (4)



compiled by Angela Anderson

20. Short about seven p.m. (3)
21. And fro (2)
23. Slap on hat for bitumen road (7)
27. Work units in the Sahara (4)
28. Pedal extremity (3)

5. Egyptian sun god (2)
6. Like (2)
7. Fall agate mist from cave roof (10)
11. Four Romans (2)
12. Sounds like false one in outlier (4)
15. New stars (5)
16. In stretch to corrode (4)
22. Alternative in ore (2)
24. Potty Italian river (2)
25. In space and time (2)
26. Back in behold (2)

## Clues down

1. A shiny coal to char at nite (10)
2. Clone hoe in recent times (8)
3. Up in tide as a non-marine bivalve (9)
4. Are effects in coral (4)

This is Angela's fourth puzzle, and possibly a little more tricky than the first three. The answers (only for readers who are absolutely stumped) are on page 40.

**Listing of Books  
held in the Library of  
the Edinburgh Geological Society**

**compiled by Bill Coppock**

**(see article on page 8)**

## **Biography of geologists etc.**

James David Forbes, pioneer Scottish glaciologist	by F.F. Cunningham
James Hutton 1726 - 1797 [Scottish man of science]	by Jean Jones
James Hutton: founder of modern geology	by A. McKirdy
James Hutton and the history of geology	by Dean
Alfred Wegener - the Father of continental drift	by M. Scharzbach
Sand, wind and war	by R.A. Bagnold
Scientist of empire	by R.A. Stafford
One life	by R.E. Leakey
James 'Paraffin' Young 1811- 1883	by John Butt
William Scoresby: Arctic explorer, 1789 - 1857 [Scottish man of science]	by H. Montgomery

## **Ecology**

The ages of Gaia	by J. Lovelock
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## **Economic geology**

5th Meeting of the European Clay Groups	by J. Konta
Building stones of Glasgow	by Judith Lawson
Introduction to the petroleum geology of the North Sea	by K.W. Glennie
Gold metallogeny and exploration	by R.P. Foster
Edinburgh: an illustrated architectural guide	by McKean & Walker
Tenth Conference on Clay Mineralogy and Petrology in Ostrava, August 26-29 1986	by Conference on Clay Mineralogy
Energy resources: geology, supply and demand	by G.C. Brown
Dundee	by McKean & Walker

## **Economic geology (continued)**

**A guide to colour to precious and semi-precious stones.**

**by Bauer & Bouska**

**Ninth Conference on Clay Mineralogy and Petrology in Zoolen**

**Building stones of Edinburgh**

**by I.T. Bunyan**

**Scotland and petrochemicals**

**by T. Patten**

**Petroleum geology**

**by F.K. North**

## **Evolution**

**Bones of contention**

**by R. Lewin**

**The problems of evolution**

**by Mark Ridley**

**Wonderful life**

**by Stephen Jay Gould**

**The book of life**

**by Stephen Jay Gould**

**Darwinism defended: a guide to the evolution controversies**

**by Michael Rose**

**The fossil record and evolution**

**by L.F. Laporte**

**Extinction**

**by D.M. Raup**

**The Nemesis affair**

**by D.M. Raup**

**Lucy: the beginnings of humankind**

**by Johanson & Edey**

**The evolution of vertebrate design**

**by Leonard B. Radinsky**

**Evolution**

**by Scientific American**

**Missing links: the hunt for earliest man**

**by John Reader**

**An urchin in the storm: essays about books and ideas**

**by Stephen Jay Gould**

**The new catastrophism, the importance of the rare event in geological history**

**by D. Ager**

**Catastrophic episodes in earth history**

**by C.C. Albritton**

**Catastrophes and earth history**

**by Berggren & Van Couvering**

## **Evolution (continued)**

The panda's thumb	by Stephen Jay Gould
Life: an authorised biography	by R. Fortey
Bully for brontosaurus	by Stephen Jay Gould
Eight little piggies	by Stephen Jay Gould
Ever since Darwin: reflections in natural history	by Stephen Jay Gould
Evolution: a biological and paleontological approach	by P. Skelton
The flamingo's smile: reflections in natural history	by Stephen Jay Gould
Hen's teeth and horse's toes	by Stephen Jay Gould

## **General Geology**

Earth	by Press & Siever
Great geological controversies	by A. Hallam
Natural disasters	by D. Alexander
Understanding the earth	by G.C. Brown
Callin's rocks & fossils: the ultimate guide	by A.B. Busbey
Cambridge encyclopedia of earth sciences	by Cambridge UP
The story of the earth	by Cattermole & Moore
Geology and society	by D.R. Coates
Science of the earth	by A.J. Eardley
Geology principles & methods	by J. Dercourt
Principles of physical geology	by Arthur Holmes
Time's arrow, time's cycle	by Stephen Jay Gould
From mineralogy to geology: the foundations of a science, 1650 - 1830	by Rachel Lauden
Putnam's geology	by E.E. Larson

## **General Geology (continued)**

Putnam's geology	by E.E. Larson
Environmental geology	by E.A. Keller
Basin and range	by John McPhee
The earth	by E.J. Tarbuck
Geology and man	by J. Watson
Geological howlers, boners and bloomers (Glasgow G.S.)	by W.D.I. Rolfe
The dark side of the earth	by R.M. Wood
Down to earth	by H.E. Wilson
Principles of earth science	by A.N. Strahler
The dynamic earth	by Scientific American

## **Geological maps and mapping**

Image interpretation in geology	by S.A. Drury
The geological map, an anatomy of the landscape	by E. Edmonds
Introduction to geological maps and structures	by J.L. Roberts
Exploring earth from space	by Jon Erikson

## **Geology of the British Isles**

A geology of Ireland	by C.H. Holland
The geology of the Lothians and south east Scotland	by G.Y. Craig
Excursion guide to the geology of the Aberdeen area	by N.H. Trewin
Geology of Scotland	by G.Y. Craig
The Lake District	by Cumberland Geological Society
London: illustrated geological walks: book 2	by E. Robinson

## **Geology of the British Isles (continued)**

Excursion guide to the geology of east Sutherland and Caithness	by N.H. Trewin
Geology of Scotland	by G.Y. Craig
Britain before man	by F.W. Dunning
Ardnamurchan	by C.D. Gribble
Geology of the Glasgow district	by B.J. Bluck
London: illustrated geological walks: book 1	by E. Robinson
Assynt district of Sutherland	by M.R.W. Johnson
Geology of Arran	by McDonald & Herriot
The Midland Valley of Scotland	by I.B. Cameron
Geology of the country around Girvan	by I.B. Cameron
British regional geology	by I.B. Cameron
Field excursion guide to the Carboniferous volcanic rocks of the Midland Valley of Scotland	by B.G.J. Upton
Tertiary and Post-Tertiary geology of Mull, Loch Aline and Oban	by E.B. Bailey
Geological highlights of the West Country	by W.A. MacFadyen

## **Geomorphology**

Islands	by H.W. Menard
Global geomorphology	by M.A. Summerfield
The hidden landscape	by R. Fortey
Geology and scenery in Scotland	by J.B. Whitton
The evolving coast	by Richard R. Davis Jnr.
Scotland (geomorphology of the British Isles)	by J.B. Sissons
Sand	by Raymond Siever



## **Geomorphology (continued)**

- |  |                    |
|--|--------------------|
| Earth's changing surface                           | by M.J. Selby      |
| Ice ages: solving the mystery                      | by Imbrie & Imbrie |
| The Macmillan field guide to geological structures | by J.L. Roberts    |

## **Geophysics, earthquakes, geomagnetism etc.**

- |  |                        |
|--|------------------------|
| Global geophysics  |                        |
| Introduction to geomagnetism   | by W.D. Parkinson      |
| Earthquakes and geological discovery   | by Bruce A. Bolt       |
| Earthquakes  | by S. Van Rose         |
| Paleomagnetism: principles and applications in geology, geophysics and archaeology | by D.H. Tarling        |
| Field geology, minerals and rocks  | by J.F. Kirkaldy       |
| Inside the earth   | by Bruce A. Bolt       |
| Mathematical modelling in electromagnetic prospecting methods                      | by V. Bezvoda          |
| Acts of the International Conference on Seismic Zones in the Mediterranean Area    |                        |
| Earthquakes and volcanoes  | by Scientific American |
| Earthquakes: a primer  | by B.A. Bolt           |

## **History of geology**

- |                               |               |
|-------------------------------|---------------|
| Piltown. A scientific forgery | by F. Spencer |
|-------------------------------|---------------|

## **Hydrogeology**

- |                    |                    |
|--------------------|--------------------|
| The Water of Leith | by Jamieson & Hope |
|--------------------|--------------------|

## **Marine geology**

**Marine geology**

**by Roger N. Anderson**

**Science at sea: tales of an old ocean**

**by T.H. Van Andel**

## **Palaeontology, fossils, dinosaurs, etc.**

**Prehistory**

**by Giovanni Pinna**

**Fossils: the key to the past**

**by R. Fortey**

**Time, life and man**

**by R.A. Stirton**

**Basic questions in palaeontology**

**by H. Otto**

**Elements of micropalaeontology**

**by G. Bignot**

**Dinosaurs past and present: Vol 1**

**by Sylvia J. Czerkas**

**Dinosaurs past and present: Vol 2**

**by Sylvia J. Czerkas**

**Wandering lands and animals**

**by E.H. Colbert**

**Fossils of the world**

**by V. Turek**

**Systematics and the fossil record**

**by Andrew B. Smith**

**Dinosaurs from China**

**by Dong Zhiming**

**Vertebrate palaeontology**

**by A.S. Romer**

**Fossil horses**

**by B.J. MacFadden**

**The dinosaur heresies**

**by R. Bakker**

**Discoverers of the Lost World**

**by G.G. Simpson**

**Fossils and the history of life**

**by Simpson**

**Quaternary insects and their environment**

**by Scott R. Elias**

**Mammal Evolution**

**by Savage & Long**

**The Dinosaur heresies**

**by R. Bakker**

**Dinosaurs, spitfires and sea dragons**

**by C. McGowan**

**Fossils - The McDonald encyclopedia of**

**by P. Arduini**

**On the track of Ice Age mammals**

**by A.J. Sutcliffe**

**The crucible of creation**

**by S.C. Morris**

**Atlas of invertebrate macrofossils**

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# **ROCKWORD PUZZLE No. 4**

## **SOLUTION TO PUZZLE ON PAGE 28**

### **Clues across**

1. ACHANARRAS
8. EAST
9. TILLITE
10. FILL
13. VIA
14. ARENITE
17. EG
18. NOT
19. TERM
20. EVE
21. TO
23. ASPHALT
27. ERGS
28. TOE

### **Clues down**

1. ANTHRACITE
2. HOLOCENE
3. NAIADITES
4. REEF
5. RA
6. AS
7. STALAGMITE
11. IV
12. LIER
15. NOVAS
16. ETCH
22. OR
24. PO
25. AT
26. LO



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