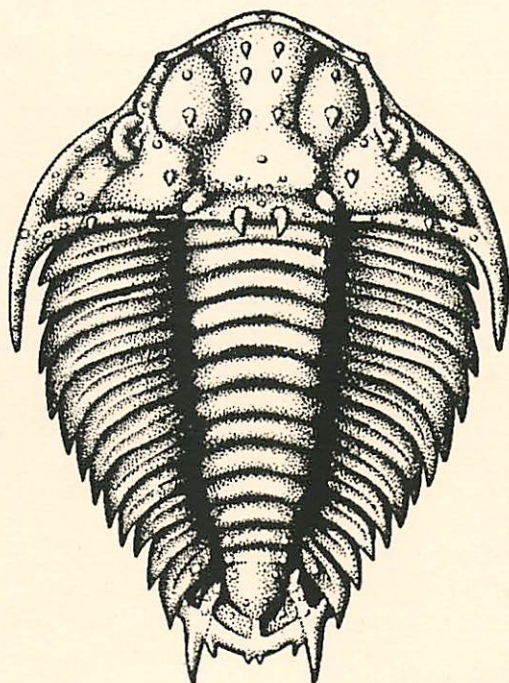


The Edinburgh Geologist

Magazine of the Edinburgh Geological Society

Issue No. 31

Autumn 1998



**Incorporating the Proceedings of the Edinburgh Geological Society
for the 163rd Session 1996-1997**

THE EDINBURGH GEOLOGIST

Issue No. 31 Autumn 1998

Cover Illustration

The cover illustration shows a drawing of *Hemiargus inghami*, a trilobite from the Ordovician Stinchar Limestone near Girvan. This species lived along the coast of Laurentia, but found Avalonia a bit on the cool side.

(see article by Phil Stone, 'The Geology of Devolution' on page 8)

The drawing is taken from a paper by R P Tripp (*Palaeontology*, 1979, Vol. 22, 339-361) and is reproduced by kind permission of the Palaeontological Association.

Acknowledgements

Publication of THE EDINBURGH GEOLOGIST is supported by grants from the Peach and Horne Memorial Fund and the Sime Bequest

Published October 1998 by
The Edinburgh Geological Society

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Murchison House
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ISSN 0265-7244

Price £1.50 net

It is  my pleasure to have b

Editorial
by Alan Fyfe

It is my pleasure to have been appointed as the editor of THE EDINBURGH GEOLOGIST and to welcome you to the thirty-first edition. I follow a long line of illustrious editors and hope that I am able to maintain the standard of the publication. My thanks are due to the outgoing editor, Andrew Highton for filling me in on the pitfalls and helping to get me started.

This issue sees a slightly altered format, though the changes are largely cosmetic and I have attempted to maintain the general look and feel that has evolved over the years. My aim will be to keep it readable by all, and also interesting to all. In addition, I am keen to see the magazine well-illustrated and I thank the authors of the articles in this issue for helping me in this quest. Indeed, my job has been made all the more pleasurable by the way in which contributors (and potential contributors) have been so willing to co-operate with my whims and fancies.

My thirst for illustrations was answered as if from heaven when David McAdam told me that he had asked Alison Kerr if she would submit her sketches on the Hexham weekend field excursion to this magazine. Her husband, Tom, has provided a continuum describing the trip.

I am very pleased to be able to publish another contribution from Phil Stone, who in this issue takes a light-hearted look at the topic of devolution as it applies to the closing of the Iapetus Ocean in Ordovician to Silurian times. I was also pleased to receive an article on the Victorian naturalist Gideon Mantel, sent to me by Dennis Dean in the States. I had taken note that Dennis had joined the society as a Corresponding Fellow... now I know what a Corresponding Fellow is and it is this Editor's wish that we had more of them!

Part of the magazine has a definite Clough Connection and includes a synopsis of the Clough Medal Lecture given by Jack Soper this year. A brief history of the Clough Memorial Medal and Award, together with a list of all medallists and award-winners is found in these pages too.

Some of the editing of this issue was done while I was on an offshore geophysical and geological expedition west of Rockall. We spent a little time searching for a buried Tertiary igneous centre and I was glad when Ken Hitchen offered to write a few words for me... perhaps something of a captive contributor! Not so captive were Andrew McMillan and Mike Browne who gave me a report of a meeting on Building Stones held in Murchison House last year. My first reaction on reading it was to wish that I had been to the meeting myself!

Editorial

I am grateful to Paul Carter, Ian Basham and Fiona Owen for their book reviews. All three are reviewing BGS publications, which are available at the Sales Desk in Murchison House or through the Society Publications Secretary if you prefer. If anyone knows of any new publications that might be reviewed in these pages, I would be grateful if you could let me know.

The Proceedings at the end of the magazine were provided for me by David Land. I have set these in a contemporary style in order to make them look interesting to read... which they are... have a peek!

Lastly (well almost), I should like to say what you have no doubt heard so many times before... This is **your** magazine and its success depends on your contributions. If you think that any of your colleagues are working on something that might be of interest to other readers, please let me know. I shall be quite discreet when I approach them!

Lastly (really), I would like to bring publication of **THE EDINBURGH GEOLOGIST** back to a six-monthly schedule. Assuming that I have enough copy, the next issue is due out in March or April 1999. The copy date will be 1st February. I look forward to hearing from at least some of you before then!

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Note: In the last issue of the Edinburgh Geologist, the figure from Phil Stone's article 'Geology for Cannibals' was inadvertently omitted. If anyone would like a copy of this figure, they should contact Phil at BGS (direct line (0131) 650 0253).

The first issue of THE EDINBURGH GEOLOGIST was published in March 1977. It was the brainchild of Helena Butler, who became the first Editor. In that first issue, the aims of the magazine were set out as follows:

- to provide the amateur members with articles written at an appropriate level by the professional geologist and to carry news of current geological research;
- to allow amateur members to write about their own particular interests in geology, either in articles or short notes on specific topics;
- to serve as a general information bulletin in which special meetings, exhibitions, publications and social events may be announced.

With articles by Doug Fettes, David Greig, Nick Rock, Graham Smith and a lengthy discourse on the Southern Uplands by Euan Clarkson, the first issue set off to fulfil these aims. Looking back, it seems that professional geologists have generally been the most common contributors... and a brief look through this issue will show that this is still the case. In the first few issues, there appeared, in addition to the scientific articles, the first book review, a crossword and a poem!

The magazine was at first published twice a year and in Spring of 1979, the editorial team was expanded to include Andrew McMillan, who was able, by dint of being on the staff of the then Institute of Geological Sciences, to coax, cajole and otherwise inveigle his colleagues into writing for the magazine. In Autumn 1980, the first issue in the present A5 format was published. Until then, it had been printed on rather more inconvenient A4. It is interesting to note that in 1990, the Scottish Journal of Geology decided to change **their** format from a handy bookshelf-height size to A4!

Autumn 1984 saw the first of a number of short articles entitled 'Strange Earth', written by Bill Baird, now our Society's President. Bill kept these articles going, on and off, for twelve years, the most recent ('Strange Earth 17: The Gibraltar Waterfall') being published in volume 29. It is this Editor's hope that Bill's elevated position does not mean that he will not be contributing again - the articles are all brief but make a fascinating set.

In Spring of 1985, Helena and Andrew bowed out of their editorial rôle to make way for the new team of Frances Lindsay and Lizzie Davenport. Helena had been at the helm for eight years, which is a record never since surpassed and in that time had

The Edinburgh Geologist - the first thirty issues

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seen her innovation evolve from little more than a cyclostyled broadsheet to a very creditable publication.

Unfortunately, the magazine then went through somewhat turbulent times. Frances and Lizzie, though producing two fine issues, found the editorship too daunting a task and in 1988, the job was taken over by Margaret Ford. Again, Margaret was unable to continue in the post and in Spring of 1989, volume 22 was published under the editorship of Clive Auton. In this issue, it was decided to incorporate the Proceedings of the Society into THE EDINBURGH GEOLOGIST and this has been the pattern ever since.

Clive kept the now tried and tested format and formula going for several years. Lack of copy meant that the publication had to become annual. One of the positive trends that emerged at this time was the introduction a larger number of shorter articles, rather than the more weighty contributions that were to be found in some of the earlier issues. There were also further poems, but alas no more crosswords.

After six years in the post, Clive handed over editorship to Andrew Highton, also of the British Geological Survey. Andy remained as editor until last year, when he, rather gratefully I feel, handed editorship over to me. Editorship can be a particularly thankless task and I have in the past found myself shunned at social events by those trying to avoid being asked to contribute something to a newsletter of which I was editor. But it will not work... I shall seek you out!

As regards the future shape of the magazine, I shall be trying to resume the twice-annual publication, but it is really up to you, the readers, to help in this regard and for at least some of you to become writers as well! During the last few years, under the editorship of Caroline Paterson, the Society Billet has developed into a broader-concept publication in which meetings, field trips and social events are promoted, so the third of the original aims of THE EDINBURGH GEOLOGIST is now dealt with on what is a more appropriate platform. However, that still leaves us with articles written for amateur members by professional geologists and contributions by amateur members themselves. I am pleased to say that we have articles of both genres in this issue. And of course, I am always happy to publish pertinent poetry... and even another crossword!



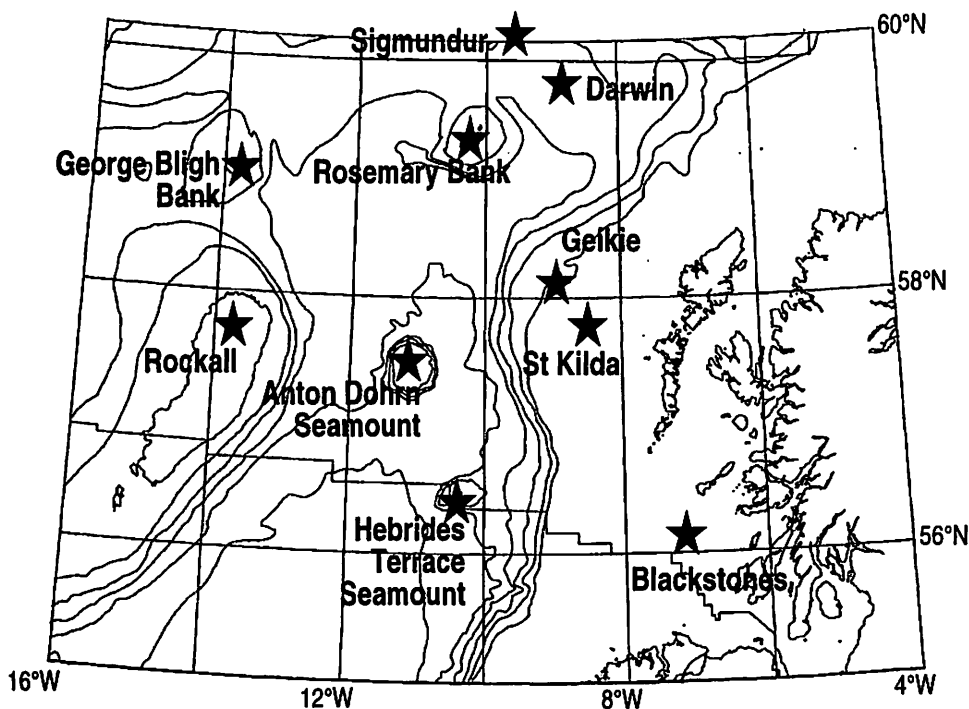
Excuse me, Sir! Have you
seen my volcano?

by Ken Hitchen

One of the more interesting results of the BGS offshore regional mapping programme, conducted over the last 30 years, has been the realisation that the British Tertiary Volcanic Province (represented onshore by the Skye, Mull, Rum, Ardnamurchan and Arran centres and associated lavas and intrusions) is but a very small part of the total North Atlantic Igneous Province. Offshore, Early Tertiary basaltic lavas subcrop over thousands of square kilometres of the North Atlantic Ocean and also crop out at the sea bed in places such as Rockall Bank and the Hebrides Shelf (where they have been proved to be nearly 2.5 km thick NW of Lewis). In the Faeroe Islands the lavas have been proved, by mapping and deep drilling, to be over 5.5 km thick. The offshore area also has numerous central igneous complexes which are generally larger than those onshore. St Kilda and Rockall Island are remnants of such features. The Rosemary Bank, Anton Dohrn and Hebrides Terrace seamounts are former volcanoes which, although partially eroded, remain huge positive features on the sea bed. For example, Anton Dohrn, the summit of which is approximately 500m below sea level, is actually Scotland's (and Britain's) highest mountain - higher from top to bottom than Ben Nevis is above sea level. Most of the offshore centres have probably now been discovered and many are described in the technical literature. Examples are: Blackstones (McQuillin *et al.* 1975), Erlend (Gatliff *et al.* 1984), Geikie (Evans *et al.* 1989), Darwin (Abraham and Ritchie 1991) and Sigmundur (Ritchie *et al.* 1998). All the centres are characterised by positive gravity anomalies which probably reflect the presence of a basic pluton below each former volcano. This pluton is the frozen remains of the reservoir of magma which was liquid at the time the volcano was active.

Continued offshore mapping in the 1990s by the BGS in the deep water areas west of 10°W, facilitated by the renewed search for hydrocarbons on the Atlantic Margin, has allowed the opportunity to search for undiscovered central igneous complexes which may be imaged by new gravity, magnetic and seismic data. Many positive gravity anomalies on Rockall Plateau (west of Rockall Island) are now considered to be due to plutons associated with former volcanoes (Mould *et al.* 1996). Having the opportunity to name these features is one of the advantages of being an explorationist in this frontier area. Having the opportunity to test one's geological interpretation by being the first to run a seismic line across an area is both exciting and fraught with the potential for disappointment. So it was in June this year when the *RRS Challenger*, on hire to BGS for survey work on the Atlantic Margin, shot a seismic line across an anomaly in the NW Rockall Trough. The anomaly is nearly

**Excuse me, Sir! Have you
seen my volcano?**



Map of the continental shelf west of Scotland showing the main Tertiary volcanic centres discovered to date.

circular and only slightly smaller in dimensions and amplitude than the ones associated with the proven Darwin and Sigmundur centres. As the ship steamed closer to the anomaly centre, speculation on board increased as to the possible size and shape (and name?) of the former ?volcano. Lavas were imaged on the analogue seismic records being printed out in real time on board the ship. Would they suddenly describe a dome representing the former conical shape of a volcano? Well, they didn't. The deep geology along the line remained as flat as a pancake. No volcano, but egg on the face of the geologist. The allotted name was shelved for another day.

However the question remains of how to explain the anomaly. Possible explanations might be: (1) an intrusion so deep in the crust that it could not be imaged using the seismic equipment deployed (2) a structural high composed of metamorphic

Excuse me, Sir! Have you
seen my volcano?

basement material (unlikely considering the near circular shape of the anomaly) and (3) a perturbation on the Moho (unlikely considering the size and shape of the anomaly) (4) an error in the gravity map (unlikely considering the apparent reliability on this dataset elsewhere). The field work to map and explain all the features of the Atlantic Margin continues...

Note: This article was written on board *RRS Challenger* a few days after the search for the 'missing' volcano. A Force 8 gale had caused surveying operations to be temporarily suspended while the ship was jumping around like a kangaroo on heat. All tipping errors are due to the wather.

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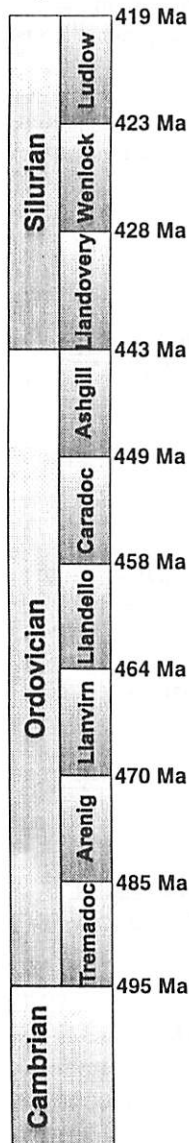
Ken Hitchen works for the British Geological Survey at Murchison House and is the geologist in charge of the Rockall Project. He has worked in the field of petroleum and marine geology for 20 years and is Secretary of the Petroleum Group of the Geological Society of London.

The Geology of Devolution

by Phil Stone

If the Earth's plate tectonic system had seized-up 500 million years ago Scotland might now be enjoying a sub-tropical climate. The palm-fringed beaches along our southern shores would be a holiday Mecca for the inland inhabitants of the Laurentian Federation. With this tourist trade at stake the recent devolution debate would have had a different focus. Should we go it alone? Should we go in with near-neighbours Newfoundland and Labrador or was the grass greener in Greenland? Paradoxically, a simultaneous debate might have occurred 1000 km to the south as Nova Scotia considered whether to quit the Avalonian Federation. In the event, the Iapetus Ocean closed, the Atlantic Ocean opened, and we finally arrived at our present geography, geological immigrants on the fringe of Europe. Somehow auld Scotland had passed Nova Scotia going the other way. You might well wonder how this bizarre crustal shuffle came about and just what is the evidence that enables us to work it out.

It was the fossils that started it all. Cambrian and Ordovician trilobites from Scotland (such as *Hemiarages*, see front cover) are pretty similar to those in parts of North America, from Newfoundland down the Appalachians. Trilobites of the same age from England are quite different but have affinities with others in Nova Scotia and Morocco. Several other fossil groups show a comparable bipartite distribution and it was this sort of evidence which led Tuzo Wilson to ask 'Did the Atlantic close and then re-open?' in his seminal *Nature* paper of 1966. Up until then proponents of continental drift had been largely filed away with flat-earth enthusiasts and the victims of alien abductions, but things were about to change. The plate tectonic revolution swept scientific orthodoxy aside and almost any geological convolution seemed possible. Before long it was commonly accepted that an early Palaeozoic Ocean opened between 600 and 500 million years ago but then closed again before the Atlantic split the newly-merged continents along not-quite-the-same line. The old ocean was named after Iapetus, the father of Atlas. On its northern, sub-tropical shores lay the continent of Laurentia; to the south was temperate Avalonia on the margins of the circum-polar continent of Gondwana (Figure 1).



The Geology of Devolution

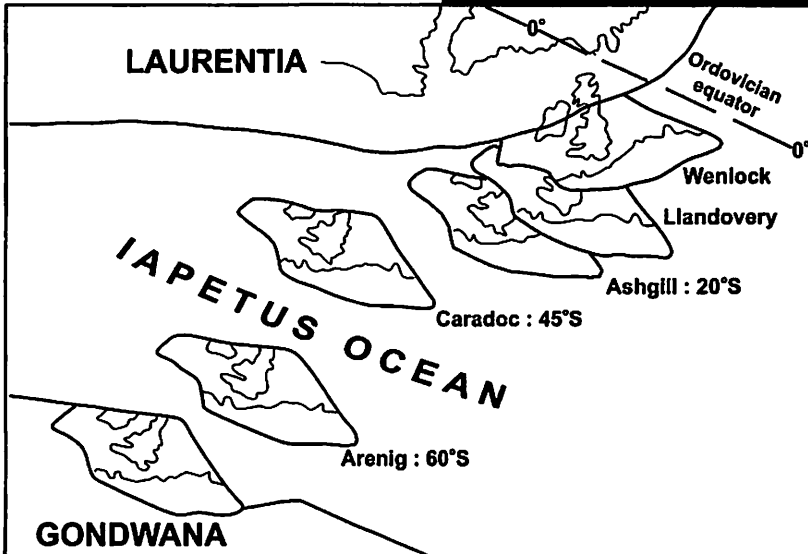


Figure 1. The drift of Avalonia away from Gondwana and across the Iapetus Ocean relative to a stationary Laurentia. (after Fig.5 in Pickering & Smith, 1995)

The mismatch between closing of the Iapetus Ocean and opening of the Atlantic left some bits and pieces trapped on the 'wrong' side (Figure 2). One of those bits is Scotland but our Laurentian credentials are only really convincing from the Hebrides and the northern Highlands down to the Highland Border. South of there, things are a wee bit less certain as the foundations of the country turn out to be the geological flotsam of the Iapetus Ocean, swept up and accreted onto the edge of Laurentia as the oceanic lithosphere was subducted. A big contribution was added about 470 million years ago when an oceanic volcanic arc collided with an early Midland Valley continental fragment and shunted it northwards to crush the oceanic rocks of the Highland Border Complex and deform the Dalradian. Part of the arc causing all the trouble ended up as an obducted ophiolite fragment on top of the Midland Valley basement block; we see a bit of it now at Ballantrae.

Thereafter, with subduction established under the new and extended Laurentian margin, the end of the Iapetus Ocean was inevitable. The Southern Uplands was sequentially scraped off the sea floor and built-up into a thrust belt advancing south. The sand grains in its rocks tell of other volcanic arcs, now lost for ever. Its northern, Ordovician belt still has convincing Laurentian faunal links but by the time the southern margin was added, in the middle Silurian, Laurentia and Avalonia had converged; Iapetus was no more. Scotland came out on top in this first meeting with

The Geology of Devolution

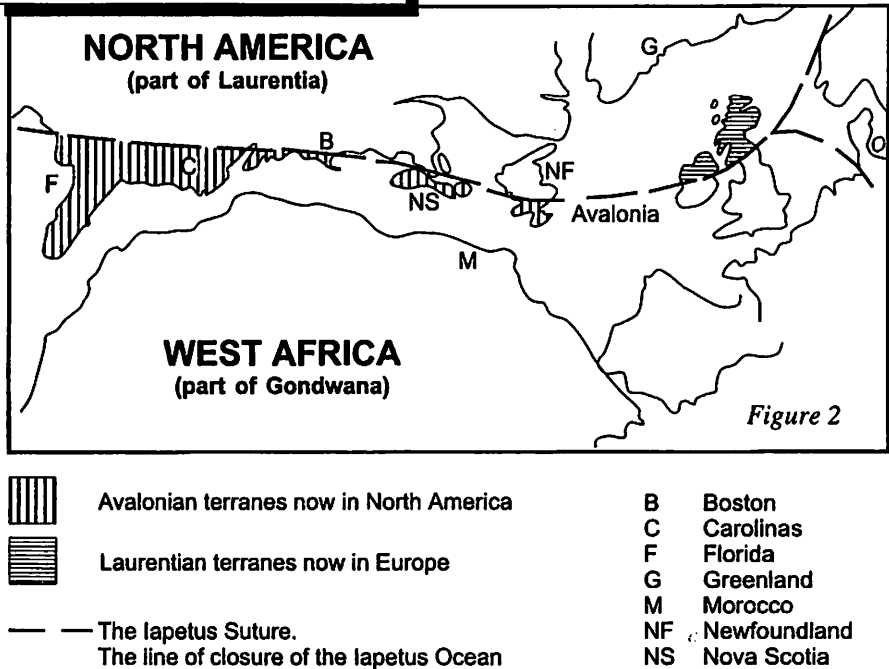


Figure 2. The pre-Atlantic relationship of Laurentia and Avalonia (after Fig.1 in Nance & Thompson, 1996)

England as the margin of Laurentia over-rode Avalonia. The Southern Uplands thrust front marched on southwards into Avalonia with a load-induced foreland basin ahead of it. Some of the rocks deposited therein are now preserved as part of the Windermere Supergroup in the south of the English Lake District.

Beneath the Southern Uplands thrust belt the plane of collision, the Iapetus Suture, dived northwards (Figure 3). We can now image this plane seismically and see that eventually it intersects the Moho somewhere under Edinburgh. So, at about 30 km depth, Edinburgh is underlain by Avalonian mantle. Above that, but under a surface skin of sedimentary rocks between 5 and 10 km thick, the associations of the crystalline crust beneath southern Scotland are also a bit ambiguous. The Midland Valley crust apparently extends south of the Southern Upland Fault to underlie the northern, Ordovician part of the Southern Uplands. Farther south, under the Silurian sector, the crust is significantly more magnetic and this character is shared with Avalonian crust, south of the Solway and in the footwall of the suture. Did a detached piece of Avalonia get trapped on the 'wrong' side during the final closure of Iapetus? There certainly seems to have been some late movement between this

The Geology of Devolution

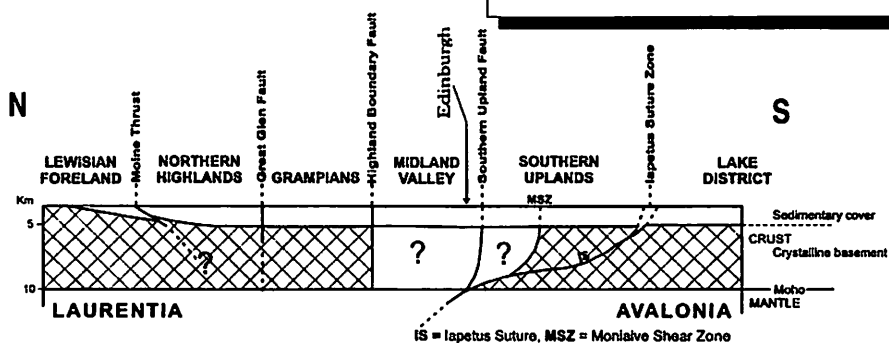


Figure 3 - a sketch cross section from NW Scotland to the English Lake District

suspect block and the Midland Valley crust beneath the Ordovician part of the Southern Uplands. The surface expression of this movement is the Moniaive Shear Zone, up to 4 km across, which stretches along the Southern Uplands beneath Glenluce, Moniaive and Drumelzier, more or less coincident with the Ordovician - Silurian boundary.

All of this means that the geological join between Laurentian Scotland and Avalonian England is not too easy to define. At one extreme, the influence of the Southern Uplands thrust belt extends into the southern Lake District and inliers of Southern Uplands rock *sensu stricto* span the border at Carter Bar. The Iapetus Suture itself does not make it to the contemporary level of erosion but remains buried beneath the Carboniferous strata of the Solway - Northumberland basin. In fact, since the suture plane was reactivated as a normal fault during the development of that basin, one important manifestation of the suture might be the Maryport - Stubbs Fault system across northern England. At deeper, mid-crustal levels, bits of Avalonia might get as far as Moniaive; still deeper and we have Avalonian mantle under the whole Southern Uplands. This is complicated enough but remember that there were other players in the great Caledonian terrane exchange. Europe might have got Laurentian Scotland and the northern half of Ireland (that's half the whole island, not just Northern Ireland) but North America got the southern bit of Newfoundland (paradoxically, the Avalon peninsula, 'type area' for Avalonia), Nova Scotia, large chunks of New Brunswick and Maine and even Boston, quintessential New England; arguably it got bits of Carolina and Florida as well as Scandinavia, originally part of Baltica, the third participant in this geotrading, got bits of the Norwegian coast but that's another story.

This is probably not the place to debate who got the best of the bargain, which all comes down to quality versus quantity. Until the Atlantic goes into reverse and

The Geology of Devolution

provides the opportunity to swap back there is not a lot to be done about our present arrangements. However, in that respect the future doesn't look too bright since we now live on a continental margin. That's not too healthy a place to be during subduction and inevitable continental collision. When auld Scotland is finally reunited with Nova Scotia who will come out on top then?

The following could be a start if you want more details of the geological act of union:

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Dr Phil Stone works for the British Geological Survey at Murchison House and is the geologist in charge of the Southern Uplands Project. He has worked on the Southern Uplands and Lake District for near on 20 years. This is the second of Phil's articles published in the Edinburgh Geologist taking a light-hearted look at geology.

The New Highlands Controversy - the position at November 1997 -

Dr. Jack Soper
Clough Medallist 1998

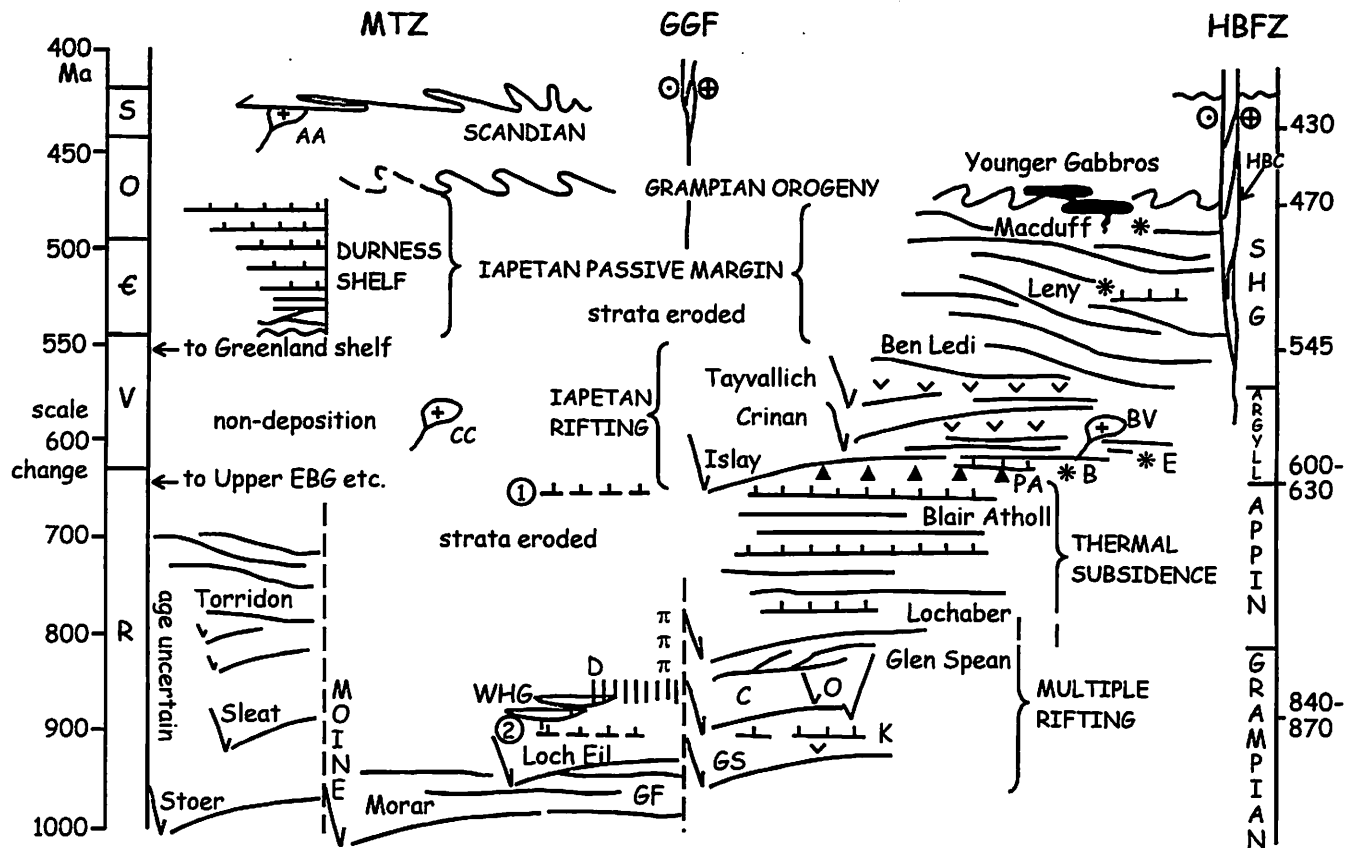
I would define the New Highlands Controversy in terms of two interlinked questions:

- Was the Grampian orogeny that affected the Dalradian rocks of the Highlands of Proterozoic or Palaeozoic age?
- Was the 'Knoydartian' deformation that affected the underlying Moine and Grampian strata in the Proterozoic contractional or extensional?

Geochronology linked to metamorphic and structural studies favours Neoproterozoic orogeny in the Highland rocks, but has failed to define the limits of the putative orogen in either time or space. Stratigraphical-structural studies seem to indicate continuous sedimentation from the Riphean into the Palaeozoic, with no orogenic unconformities. Conflicting data have multiplied in recent years and increasingly complex and ultimately non-actualistic geotectonic models have been proposed to accommodate them.

Palaeozoic	Ordovician	443 Ma
	Cambrian	495 Ma
Proterozoic	Vendian	545 Ma
	Riphean	600 - 630 Ma

The Scottish Highlands comprise a tiny, but intensely researched part of the Caledonian-Appalachian orogen, and it is essential to view them in their regional context. Comparative stratigraphy links Scotland to the Greenland margin of Laurentia, with shared history of extension-related sedimentation followed by widespread carbonate shelf development in the Riphean, Iapetan rifting in the Vendian and passive margin sedimentation in the Cambro-Ordovician, with no evidence of contemporary contractional deformation. This led me to suggest, at the Keyworth meeting in 1994, that the 'ground truth' of the evidence for Neoproterozoic orogeny in Scotland should be reassessed. Clough would, I think, have approved of going back to the field relationships. The results of the ensuing Highlands Workshops have been remarkable; for example the Older Granites prove to be pre-tectonic intrusions whose age more likely dates vigorous extension than orogenic contraction. Concurrently, new U-Pb single-mineral ages are eliminating some of the stratigraphical conflicts inherent in the older Rb-Sr and bulk fraction U-Pb data.



Cartoon to illustrate the tectonostratigraphical development of the Scottish Highlands, showing rift basins and associated magmatism, thermal sag sequences and subsequent orogeny. Vertical scale is time, not thickness (for key, see next page)

A decisive answer can now be given to the first question. Stratigraphical and palaeontological evidence from Scotland and U-Pb dating from Connemara, combined with provenance studies on orogenic detritus in both areas, unambiguously define the Grampian orogeny as a very short-lived event around 470 Ma, near the Arenig-Llanvirn boundary. It was a Taconic type arc-accretion event and in that respect the Highlands are simply an extension of the Appalachian orogen.

The jury is still out on the second question. Much of the old evidence for Proterozoic orogeny has gone, but >800 Ma Nd-Sm garnet ages are a problem, probably geochronological rather than geological. Whatever the outcome, the real breakthrough has been one of perception, stemming from the realisation that extension in the Highlands was long-lived, and orogeny brief. Geologists weaned on 'orogenic studies' are now questioning the assumption that every feature in an orogenic belt can be explained by contractional processes. The metabasite swarms are extension-related, and probably so too are the associated Older Granites; perhaps also the pegmatites and their enclosing shear zones; maybe even the early migmatites.

All worthwhile problems go through a period of increasing complexity before a unifying simplification emerges. Perhaps the new Secret of the Highlands will be:

- If it is Proterozoic, it is extensional;
- If it is contractional, it is Palaeozoic.

Key for figure on opposite page

AA	Assynt Alkaline Suite	HBFZ	Highland Boundary Fault Zone
B	Bonahaven Dolomite	K	calcareous rocks of Kinraig
BV	Beinn Vuirich	MTZ	Moine Thrust Zone
C	Corryairack Subgroup	O	graben precursor of Ossian
CC	Carn Chuinneag		Steep Belt
D	basic dykes in Loch Eil Group	PA	Port Askaig tillite
E	Easdale Slate	SHG	South Highland Group
EBG	Eleanore Bay Group	WHG	granite sills, protolith of West
GF	Glenfinnan Group		Highland Granite Gneiss
GGF	Great Glen Fault	*	fossils recorded
GS	Glenshirra Subgroup	v	basic volcanic rocks
HBC	Highland Border Complex	π	older pegmatites
① ②	Alternative correlations of calcareous rocks of Glendessary etc.		

EDINBURGH GEOLOGICAL SOCIETY

The Clough Memorial Medal is presented annually. The Society's Clough Committee sits to decide upon the medallist, who until this year has usually been a senior scientist who has made a major contribution to the geology of Scotland or the north of England. Last year, the rules changed, allowing the Committee, if it wished instead, to award the medal to a geologist working in Scotland or the north of England and who has made a significant impact on the international geological scene. The Committee also recommends for the Clough Award a more junior geologist who is undertaking outstanding research in Scotland or the north of England. This award is presented biennially.

CLOUGH MEDALLISTS

1935-36 Mr. David Tait	1976-77 Prof. T.S. Westoll
1938-39 Mr. Alfred Raistrick	1977-78 Prof. B.C. King
1940-41 Dr. Alexander Bremner	1978-79 Prof. M.H.P. Bott
1942-43 Mr. James Livingstone Begg	1979-80 Prof. Janet Watson
1944-45 Dr. Murray Macgregor	1980-81 Dr. Brian Sissons
1946-47 Mr. James Wright	1981-82 Dr. Walter Mykura
1948-49 Dr. Robert Campbell	1982-83 Prof. Howell Francis
1951-52 Dr. G.W. Tyrell	1983-84 Mr. Scott Johnstone
1953-54 Dr. J.B. Simpson	1984-85 Dr. Charles Waterston
1955-56 Mr. J. Selwyn Turner	1985-86 Dr. Denys Barker Smith
1957-58 Dr. John Weir	1986-87 Prof. Gordon Craig
1959-60 Mr. W.S. Bissat	1987-88 Dr. William McKerrow
1961-62 Sir Edward Bailey	1988-89 Prof. Tony Harris
1963-64 Mr. J.E. Richey	1989-90 Dr. Douglas Peacock
1965-66 Prof. W.Q. Kennedy	1990-91 Dr. Ken Glennie
1967-68 Dr. A.G. MacGregor	1991-92 Dr. Michael Gallagher
1969-70 Dr. G.H. Mitchell	1992-93 Dr. Euan Clarkson
1970-71 Prof. Frederick Stewart	1993-94 British Geological Survey
1971-72 Dr. James Phemister	1994-95 Dr. Henry Emeleus
1972-73 Prof. T.Neville George	1995-96 Dr. Derek Flinn
1973-74 Dr. Dorothy Rayner	1996-97 Dr. Ian Rolfe
1974-75 Prof. R.M. Shackelton	1997-98 Dr. Jack Soper
1975-76 Prof. Alwyn Williams	

CLOUGH MEDALLISTS AND AWARD WINNERS

The Medal and Award commemorate Charles Thomas Clough (1852-1916) whose life and work were described in an article by David Land in the Autumn 1995 issue of THE EDINBURGH GEOLOGIST. Clough's daughter Florrie wrote to the President of the Society, Sir John Flett in September 1934, "It would please my mother very much to do something to perpetuate Father's memory. She wishes to place £1000 in the hands of the Edinburgh Geological Society to provide an occasional award to promote the study of the Geology of Scotland and the North of England..." The committee decided to use these funds to create a medal.

The dies were cast by Pilkinton Jackson in 1936 and the medals, which are of silver were, until 1990, struck by the Royal Mint. Since then, they have been struck by Alex Kirkwood and Son of Edinburgh. On one side, the medal shows a bas-relief bust of Clough, encircled by the words 'Charles Thomas Clough 1852-1916'. On the other are the words 'Clough Memorial Award for Research' encircled by 'The Edinburgh Geological Society'. The name of the recipient, together with the date of the award, are engraved on the rim.

I thought that it would be interesting to readers to publish the list of medallists, as well as Clough Award recipients.

CLOUGH AWARD WINNERS

1962-63 Dr. J.G. Ramsay	1980-81 Dr. Roger Anderton
1964-65 Dr. Mike Johnson	1982-83 Dr. Michael Coward
1966-67 Mr. Walter Mykura	1984-85 Dr. Gordon Curry
1968-69 Dr. Michael J. O'Hara	1986-87 Dr. D. Harper
1970-71 Dr. P. Toghill	1988-89 Dr. T. Dempster
1972-73 Dr. Tony Harris	1990-91 Dr. R. Barnes
1974-75 Dr. John McManus	1992-93 Dr. J. Andrews
1976-77 Dr. Euan Clarkson	1995-96 Dr. R.W. England
1978-79 Dr. Douglas Fettes	1996-97 Dr. P.B. Wignall



A Field Trip in the Hexham area June 1998

some notes from a Kerr diary

by Tom Kerr

drawings by Alison Kerr



Weather quite variable with some heavy showers from black skies.

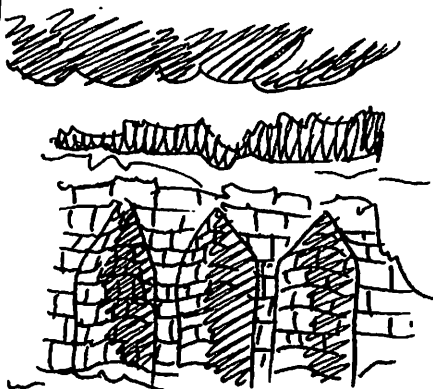
Twenty two members of the Society spent the weekend of 5th to 7th June exploring the geology and associated history in the area around Hexham.

Nenthead mining for Zn & Pb built by Quaker company.



We went underground to the carefully reconstructed mine-exhibition demonstrating the methods used for extraction, discussing the terms and conditions of miners.

Limekilns were much admired, with explanation by our local expert.



On the Saturday, Dr. Brian Young of the British Geological Survey led an excursion to the North Pennine Ore Field. We were given a good introduction to the geology by examining the core from Rookhope Borehole, which showed the weathered top of the Devonian Weardale granite unconformably overlain by the basal rocks of the Carboniferous. It was suggested that the granite caused convection cells to develop, and that

Field Trip to Hexham



Time for a look at the Roman temple of Mithras, and a casual Roman who has lost his head.

they had transported and concentrated the mineral ores that had been the basis of the area's industry.

The excursion was designed to demonstrate the zoning of the mineralisation in the ore field, with the central area dominated by fluorite and the outer area by barium minerals.

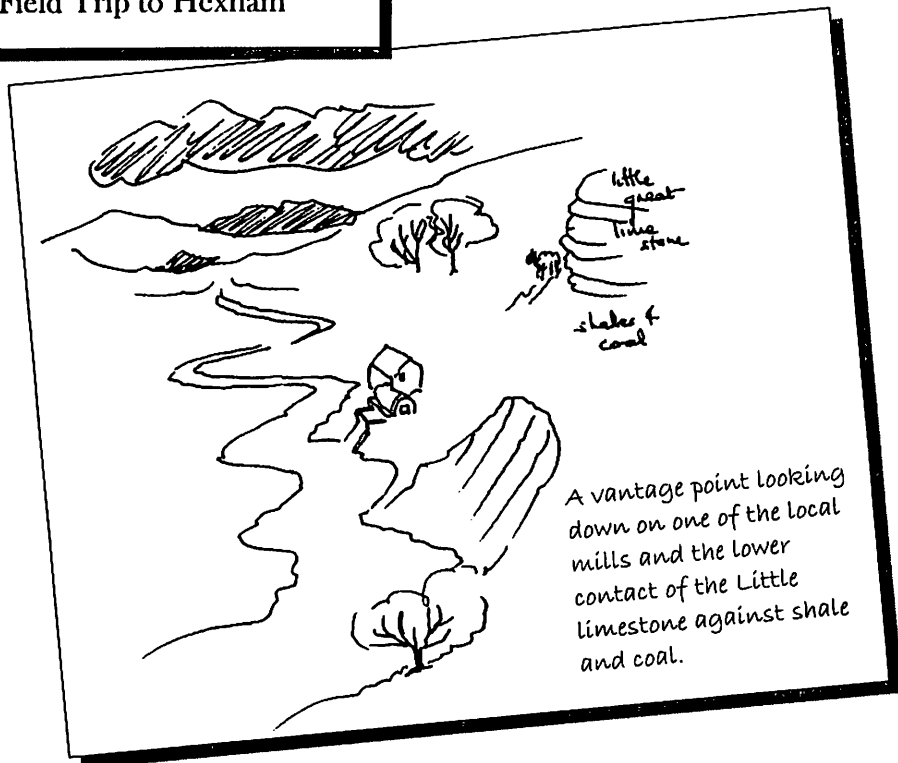
The first site at West Riggs Quarry loomed surrealistically out of the swirling North Pennine mist to show the abandoned Slit Vein standing proud where iron ore flat deposits of ankerite and siderite

Beside the waterfall examining the limestone - sandstone contact and pockets of galena glittering by the stream and in caves.



Somehow we have permission to pass the notice 'NO ADMITTANCE!'

Field Trip to Hexham



had been worked from the Great Limestone. The abandoned workings and a stream section above Nenthead allowed us to examine the rocks and minerals themselves. At this site, there were lead- and zinc-rich flats associated with one of the ore field's 'cross vein' faults. The lowest beds of the Great Limestone were visible in the stream bed, showing corals and *Chaetetes*.

The Blagill Mines at Alston are in the outer low-temperature zone and the associated spoil heaps afforded the collection of a range of barium carbonate mineral specimens such as witherite, barytocalcite and alstonite. At both of these sites, Brian was able to show how particular plants could predict the presence of heavy metal ores, a possible insight into how the old miners found productive veins. At the appropriately-name Killhope, a mid-nineteenth century lead mine has been reconstructed and shows the daily working conditions of the miners, putting the abandoned workings into their historical and social context.

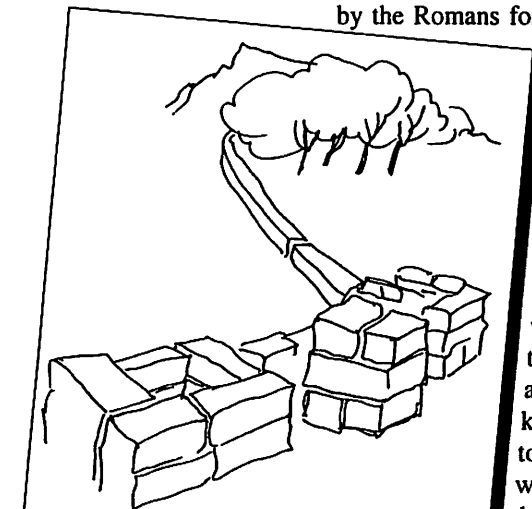
On the Sunday morning, Dr. Tony Johnson led an excursion along the Roman Wall, looking at some of the archaeological remains as well as the associated

Field Trip to Hexham

geology. The topography and the underlying Whin Sill had clearly been employed by the Romans for defensive purposes to control the

Scots. In Roman times, the weather seems to have been much as now, for the small temple of Mithras at Carrawburgh appears to have been overwhelmed by a flow of liquid peat shortly after the Romans left, thereby preserving it.

Across the road from the temple, we were able to trace outcrops of the Brigantian Group limestones and examine the associated lime kilns. Tony proved an erudite guide to the restored fort at Housesteads as well as using the view to point out the relationship between the topography and the underlying geology. In the afternoon, the group walked up the Haltwhistle Burn and explored a well-exposed succession of Upper Carboniferous rocks that had been commercially exploited in the last century.



These gates on the Roman barracks at 'Housesteads' were busy with trade. Coal from a few hundred yards across the valley fuelled the holocausts but water had to be gathered from roofs when it rained.

The weekend excursion was a great success, largely due to the skills and effort put in by the two leaders and the organiser, Ian Jackson. We would hope that the Society will be able to have a similar weekend excursion in future years as it fills a gap between short day trips and the full-week 'Long Excursion'.

Purchased a beautiful obsidian in the small shop.



When Tom and Alison Kerr are not on geological excursions, they both work as doctors in Bridge of Allen. Tom says that he took up geology through the Open University because he enjoys climbing and wanted to have some idea of what he was hanging on to. He and Alison joined the Society in 1989 after a field trip to Iceland.

Quarrying and the Built Environment in Scotland

by Andrew McMillan and Mike Browne



On the 6th of November 1997, around 80 delegates gathered in BGS Murchison House for a meeting on *Quarrying and the Built Environment in Scotland* organised by the Conservation Committee and the Environment Group of the Geological Society (London).

In recent years there has been a resurgence of interest in the use of natural materials, in particular building stone, both for conservation of historic buildings and for new construction. The opening of new quarries and the re-opening of long-abandoned workings affords many opportunities for geological conservation and education. An appreciation of the geological characteristics of building stone and geological influence on the landscape plays a critical part in designing and constructing new developments. Dialogue between professionals in a wide range of disciplines is essential for the proper consideration of issues which affect both the built and natural heritage.

Many of the presentations at the quarrying meeting illustrated these issues and demonstrated precisely how a revival in the Scottish Stone industry would meet the requirements that underpin the present Government's philosophy of achieving a sustainable environment. During September 1997 similar objectives of a conference at Stirling on Traditional Building Materials had been enthusiastically endorsed by Malcolm Chisholm, then Minister for Local Government, Housing and Transport at the Scottish Office. At both meetings issues of scale of quarrying, the careful planning of workings and use of end-product were addressed. Reports published by Historic Scotland and launched at their conference included *Quarries of Scotland* (based on the BGS photographic archive, the report illustrates the geological characteristics which determine best excavation practice and use of building stone) and the milestone strategic document *A Future for Stone in Scotland*. The latter, reviewed by the Scottish Stone Liaison Group (co-ordinated by Historic Scotland), recommends the establishment of a structure to promote all aspects of the building stone industry including industrial, academic, training and marketing sectors assisted by the establishment of a STONET of information (database) sources. The recent announcement of the establishment of the Scottish Stone Producers Group, a move welcomed by the Stone Federation Great Britain, is an important first step.

Revival of the building stone industry

At the quarrying meeting the skills required to work stone and to design buildings appropriate to the environment were discussed by Ingvál Maxwell who covered a

Quarrying and the Built Environment in Scotland

6th November 1997 - British Geological Survey, Murchison House, Edinburgh

Introduction

Phil Doughty - Conservation Committee

The future of stone in Scotland

Ingval Maxwell - Historic Scotland

Resources and accessibility

Bob Heath and Ben Tindall - Architects and Stone Consultants

Re-opening quarries

Harry Turnbull - Stirling Stone Group

The environmental issues of quarrying building stone - some rights and wrongs

Judith Kinnaird

Building stone quarries: the land-use planning context

Brian Spiers - Scottish Office Development Department

Characterisation of resources for building materials

Paul McMillan - Transport Research Laboratory

Scottish granite setts in the modern environment

Ian Wilson - Alba Stone

The keystone to Earth Heritage Conservation: awareness of the urban geological resource

Matthew Bennett and Peter Doyle - Greenwich University

Stone quarrying and geological conservation: a natural symbiosis

Rob Threadgould - Scottish Natural Heritage

The BGS computerised Scottish Quarries database

Graham Smith - BGS Edinburgh

The use of Clashach stone in the Museum of Scotland project

Bruno Miglio - W S Atkins Consultants

Working of flagstones: the sustainable solution

Kim Tullett and Wilson Manson - Buildings Renaissance Trust, Windermere

The use of quarries for public education

Norman Butcher - Lothian and Borders RIGS Committee



6000 year history of the use of stone in Scottish cultural art and buildings in half an hour! The decline of the dimension stone industry in the early 20th century, as the use of concrete increased, has seen the loss of skills and 'know how'. Bob Heath and Ben Tindall suggested that a clear requirement of any revival of the industry was to train skilled craftsmen. Architects need to be aware of stone characteristics. In this context earth scientists have a major rôle to show how the geological characteristics of stone determine best practice in excavation, building design and construction.

Planning and resources

Bob Heath and Ben Tindall described the distribution of Scottish granites of Kirkcudbright, Aberdeen and Peterhead, sandstones of Dumfries, Lothians, Fife, Angus and Moray and flagstones of Caithness and Orkney, demonstrating that it was not necessary to bring resources from all over the world since they were still available in Scotland. Ben developed the '400 yard rule', for source material, showing that historically, building stone was usually brought from within 400 yards of the site. This was locally illustrated by the twelve types of stone used in the restoration of an Edinburgh South Side House near Holyrood Park.

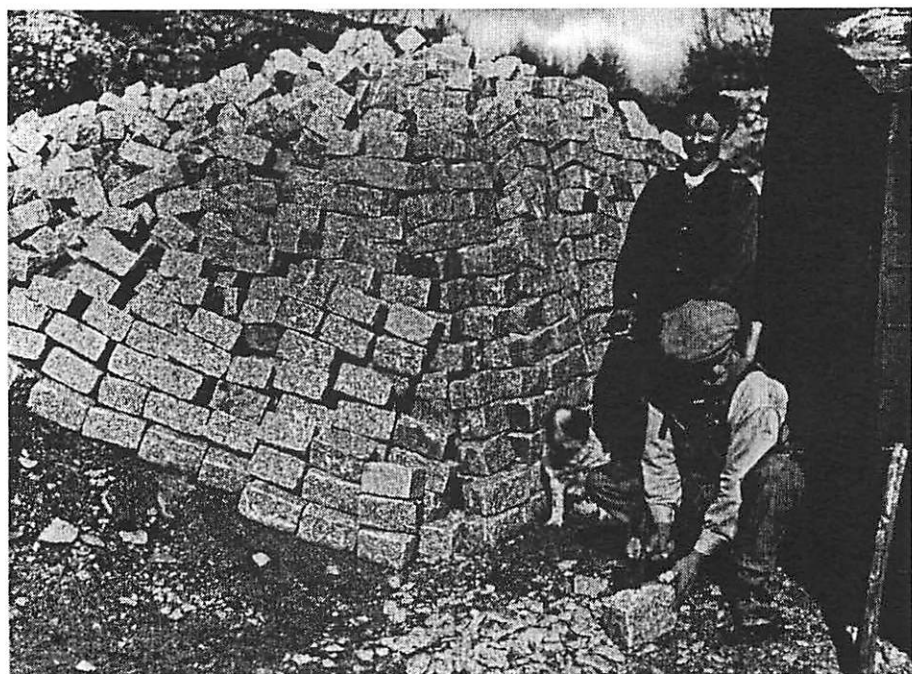
Land-use planning in the renewal of quarrying for building stone was discussed in the overall context of mineral extraction policy by Brian Spiers. Issues of concern are dust, traffic, blasting, surface and groundwater, restoration, aftercare and after use. The purpose of planning is to provide sustainability: a steady supply of mineral resources for economic growth and jobs while continuing to protect the environment. Controversy occurs because minerals can only be worked where they occur. Built heritage projects that depend on matching stone hit problems as many of the quarries that once supplied stone have been infilled or surrounded by development. Bob Heath gave an example of Dundee Customs House that was repaired with stone from the local, flooded Kingoodie Quarry, located in a nature reserve, in middle-class suburbia, and which was reopened for no longer than the restoration work. Harry Turnbull perceived that planning authorities were often hostile as they saw small-scale operations in the same light as the big-brother aggregate quarries. Over the years the Stirling Stone Group had opened some eight quarries in Scotland to supply numerous projects utilising indigenous building stone. Harry Turnbull's invitation to visit the stoneworks should be accepted by anyone visiting Stirling to witness the impressive variety of stone available from other parts of the world. Incidentally, this opportunity was taken up last September by a party on an Edinburgh Geological Society field excursion.

Granite setts used in road construction and natural hard landscaping projects were discussed by Ian Wilson, who noted that the skills in their working and laying had



largely been lost. He maintained that the Scottish granites are of good quality. However a lack of specification and a failure to apply best practice in laying setts has resulted in failures and has led to the erroneous presumption that the material itself is suspect. The large size of some foreign operations offer scale benefits and most setts currently come from Portugal. Ironically the rich tradition of the Scottish stone industry (Figure 1) included the production of grey granite setts that were exported to London from 1760. Another point, particularly relevant in stone cobbled streets in Edinburgh, is the current trend to use brick instead. Ingval Maxwell pointed out that though this appeared to be a cheaper course of action, in fact bricks have a shorter life and demand more production energy.

Paul McMillan described the geotechnical characterisation of resources for building materials. A 3D knowledge of the rock mass is a key to knowing what range of products can be prepared and he described how the rock mass could be evaluated by means of down-borehole camera and scanline outcrop measurements. Graham Smith outlined the BGS computerised Scottish Quarries database, which includes 100 000



Making setts at Craignair Hill Quarry, Dalbeattie, 1939



rock entries, 390 active mines and quarries, 9000 Scottish quarries, 1300 building stone quarries and 3800 commercial stone quarries. This digital resource should increase knowledge and awareness of Scottish building stone.

Quarrying and conservation

At first sight the relationship between quarrying and geological conservation might appear obscure. However there are many opportunities for partnerships between the exploitation of the natural resource both for construction and for educational purposes. This theme formed an important aspect of the meeting. Rob Threadgould emphasised the value of former flagstone quarrying in making available the fossil fish of Achanarras in Caithness. Kim Tullett and Wilson Manson showed that this quarry could resolve their problem of a source of flagstone for the regeneration of buildings, mainly in England, while making fresh material available for academia to study fossil fish. There would be limited extraction with opportunities for education and interpretation of the geology and the flagstone industry. Additionally there would be good control of the waste stream and the site would receive good protection. Work at Dounreay on excavating a waste pit using a diamond belt cutter, producing limited noise and vibration provided a working solution for restarting work at Achanarras. Judith Kinnaird spoke on her experiences of quarrying in South Africa, where quarries are tourist attractions and also provide good educational opportunities. The end-use of the quarry should always be considered, leaving safe, properly-angled and benched, semi-vegetated faces for geologists and biologists alike to see and savour. Rob Threadgould also discussed the reptile tracks, claw marks and tail drag marks recently unearthed at Clashach Sandstone Quarry in Moray. Stone from this quarry is being used for the Museum of Scotland extension of the Royal Scottish Museum and the new Scottish Widows Building in Edinburgh. Bruno Miglio described the innovative use of the Clashach sandstone in the Museum project as a rainscreen cladding system in which joints between adjacent sandstone blocks are left open and mortar-free. The stone had to have appropriate physical and mechanical properties as the sheer size of the thin slabs (up to 2 metres long) was a problem.

Communication

Matthew Bennett and Peter Doyle recognised that earth scientists communicated poorly with the public compared with natural scientists. With examples of stone used in graveyards (19th century Rochdale) and public areas, they demonstrated how rock type, origin and age, quarry company and date can be inscribed to bring a wider dimension for example to street furnishings. Of course, rock labelling is not new to Edinburgh (see, for example, the Meadows Pillars and Sundial) but much more



could be achieved nation-wide to narrate the geological story to the public. Norman Butcher concluded proceedings by describing the four RIGS sites in Edinburgh: the Dreghorn road cutting leading to the Edinburgh Bypass, Craigmillar mediaeval sandstone quarries, the former Torphin hardrock quarry and the infilled Craigmyle sandstone quarry. These sites are all assets for education and public awareness and are promoted during the Edinburgh Scientific Festival held in April of each year.

Question for the future

The Geological Society meeting, seen as maintaining the momentum generated at the Stirling Conference, was a prime example of encouraging a multi-disciplinary response to the demands of modern society. Archaeologists, geologists, planners, architects, academics, quarriers, stone consultants and conservationists all contributed to a synergy on stone and its past and future uses. A question springs to mind: will the '400 yard rule' have an application in the 21st century, when full environmental costs are applied to the transport of aggregates, production of steel and burning of limestone for cement and concrete products?

Suggested further reading

- Bennett, M R, Doyle, P, Larwood, J G and Prosser, C D. (editors). 1996. *Geology on your Doorstep. The role of urban geology in earth heritage conservation*. Geological Society, London.
- Historic Scotland. 1997. *A Future for Stone in Scotland*. (Hutton & Rostron).
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- The Scottish Office. 1998. *Investing in Quality. Improving the design of new housing in the Scottish countryside*. A Consultation Paper.

Andrew McMillan and Mike Browne both work in the Scotland and Northern England Group of the British Geological Survey in Murchison House. Andrew also represents BGS on the GeoConservation Commission of the Geological Society (London) and Mike is Secretary of that Society's Environment Group.

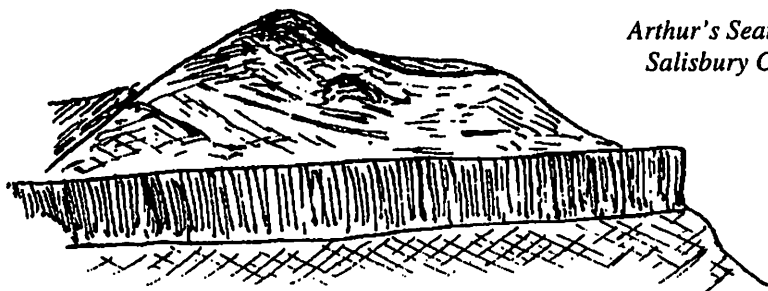
Gideon Mantell visits Edinburgh, 1850

by Dennis R. Dean



Though a man of varied accomplishments, including author, lecturer and even artist, the surgeon and geologist Gideon Algernon Mantell, F.L.S., F.G.S., F.R.S. (1790-1852) is too often remembered today only as an accidental dinosaur finder. He was, in fact, a good deal more than that but, thanks to inadequate scholarship, the unlikely story of how his wife supposedly found some fossil teeth that Gideon later turned into *Iguanodon* remains with us. In any case, Mantell was born in Sussex and lived his entire life in southeastern England, with only three minor exceptions - a weekend visit to Boulogne, a brief excursion to Wales, and one of about the same length to Scotland.

Mantell's Scottish trip began on Thursday 1st August 1850, when he left Euston Square Station in London at 9 a.m. for York. After an overnight visit there with his good friend Professor John Phillips, F.G.S., F.R.S. (1800-1874), at the latter's St. Mary's Lodge, in the ruins of a former abbey, he continued on at 9 a.m. the next day for Edinburgh. Following a long but pleasant journey in good weather that afforded him glimpses of Newcastle, Berwick and the Bass Rock, Mantell approached



*Arthur's Seat and
Salisbury Crags*

Edinburgh at dusk, "Arthur's Seat rising up most majestically in a dark mass amidst the rays of the setting sun" (J). He drove from the General (now Waverley) Station to Gibb's Royal Hotel in Princes Street, opposite the Scott Monument, and was there met by his friend John Peter Gassiot, F.R.S. (1797-1877), who had published a series of important papers on physical phenomena.

Like Gassiot, Mantell had come to Edinburgh to attend the annual meeting of the British Association for the Advancement of Science. But he had also long been an inveterate sightseer of historical architecture and for that purpose bought, probably at the train station, copies of Black's *Guide Through Edinburgh* and Rhind's *Excursions*. These copies, and his annotations within them, still exist.

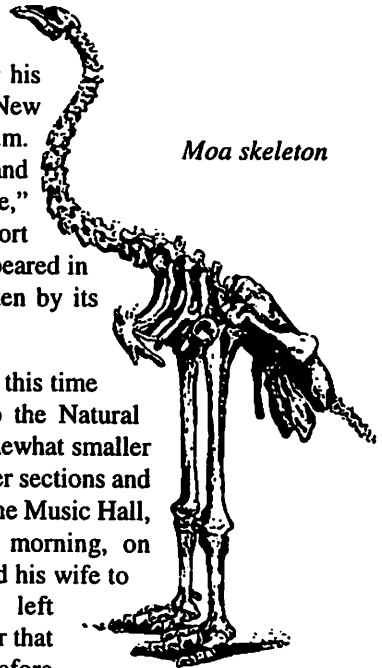
Gideon Mantell visits Edinburgh, 1850

On Saturday 3rd August, Mantell went to the Association's reception room to obtain his tickets of admission. Afterwards, he accompanied Hamlin Lee, his former medical assistant in London, to Holyrood and "visited, of course, poor Queen Mary's apartments" (J); they continued by Queen's Road round Arthur's Seat to Surgeon's Hall, driving "around the suburbs." Hamlin Lee, the son of a close boyhood friend, served as Mantell's assistant from 1838 to 1845; in the latter year he was appointed curator of the College of Surgeons, Edinburgh.

On Sunday 4th August, Mantell paid a professional visit to James Russell Lowell of Boston, the already famous American poet, whose child had become ill. Mantell then attended the Kirk with Gassiot and, in the evening, drove with him round by the Castle and through the Old Town.

On Monday 5th August, Mantell spent the whole day preparing diagrams and exhibits for his lecture that evening on the extinct birds of New Zealand, which he presented from 8:30 to 10 p.m. in the Music Hall to a crowd of between two and three thousand persons. "Very attentive audience," he noted; "passed off very well" (J). A full report of his lecture (Sir David Brewster presiding) appeared in *The Witness* for 10th August, presumably written by its geological editor, Hugh Miller.

On Tuesday 6th August, Mantell lectured again, this time "On the Upper Jaw of the Iguanodon" and to the Natural History Section (John Goodsir presiding), a somewhat smaller audience. He also attended one or two of the other sections and that evening was present at a crowded soirée in the Music Hall, where he met several old friends. The next morning, on another lovely day, he went with Hamlin Lee and his wife to see Rosslyn Chapel and Castle. Mantell left Edinburgh at 5 p.m. by train for Carlisle and after that visited Kendal, Windermere, and Manchester before returning to London at 8 p.m. on the 10th.



Moa skeleton

There was nothing particularly momentous about Mantell's one brief visit to Edinburgh, although both of the lectures that he gave were important ones. Mantell's unexpected interest in the fossil birds of New Zealand derived from the fact that his

Gideon Mantell visits
Edinburgh, 1850



elder son, Walter, had emigrated to the Antipodes in 1839, largely to escape his father, whom he would never see again. Once there, he became caught up in 'moa fever' and went in search of a live bird to exhibit, hoping thereby to make his fortune. Failing that - the moa being then extinct, but only recently so - he sent to London several shipments of moa bones, on which both his father Gideon and the comparative anatomist Richard Owen published papers. The moa remains were also deeply interesting to Charles Darwin and others concerned with the origin and transmutation of species, of whom Hugh Miller was certainly one. Mantell's *Iguanodon* lecture of Tuesday 6th August was more technical and had less immediate impact, but represented an important step forward in his successful twenty-five-year-long attempt to reconstruct the dinosaur we still know better than any other.



Iguanodon

Dennis R. Dean was last year elected as an Honorary Corresponding Fellow of the Society. He is General Editor of the History of Earth Sciences Series of Scholars' Facsimiles & Reprints and lives in Evanston, Illinois, USA. The drawing of the *Iguanodon* is published with the kind permission of Invicta Plastics Ltd., who make the plastic dinosaurs on sale at the Sales Desk in BGS, Murchison House.

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- Dean, D.R. 1998. *Gideon Algernon Mantell: a Bibliography, with Supplementary Essays*. Delmar, New York: Scholars' Facsimiles & Reprints [but an original work].
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- Nicol, J. 1844. *A Guide to the Geology of Scotland*. London. Recommended by Mantell in his *Wonders of Geology*, sixth edition (1848), p. 518n.
- Rhind, W. 1833. *Excursions Illustrative of the Geology and Natural History of the Environs of Edinburgh*. Edinburgh and London, only 72 p. Mantell's copy, Alexander Turnbull Library, Wellington, New Zealand, inscribed, "G.A. Mantell. Edinburgh 1850", not otherwise annotated.

BOOK REVIEWS



GEOLOGY OF THE HAMILTON DISTRICT

Paul Carter

This memoir deals with a district where geology has long ruled supreme. The prosperity of Hamilton, Motherwell and the surrounding towns and villages was originally built on geological riches. 'King Coal', ironstone, fireclay and limestone were worked extensively to power the growing industries of the area.

The Duke of Hamilton famously used the profits of coal to build his palace out of local sandstone, later destroyed by undermining to get even more profit from coal. His mausoleum beside the M74 has subsided by a spectacular 5 m and his lodge at Chatelherault, illustrated on the front cover of the memoir, survives as the centre of a popular country park. Geology is still of great importance, old mine workings are a major constraint to planning and exploitation of opencast coal and aggregates continues today.

In the preface, BGS Director David Falvey gives a commitment "to provide coverage of the UK land area by modern 1:50,000 scale geological maps, together with explanatory memoirs, by the year 2005." This is good news indeed. Applied geologists such as myself have often been hampered by a lack of up-to-date, basic information. It is good to see BGS getting back down to earth and returning to its original survey rôle, after flirting with being a posh scientific institute for too long.

Now to details. The Introduction gives a quick, readable romp through 400 million years of history in little more than one page. However, some jargon failed to get edited out. I stubbed my toe on "sinistral transpressive stress regime." Two full colour maps are included, showing the topography and solid geology of the district. I found these most useful but beware: the colour scheme is not the same as on the 1:50,000 scale map and some of the colours, e.g. those for the Devonian and Middle Carboniferous, look very similar.

The District is fortunate in containing two important Silurian inliers, the Lesmahagow and Hagshaw Hills inliers, and these are dealt with in some detail. The geology of the inliers gives an insight into the development of basins in northern Britain at this time but it is clear from the text that much still remains conjectural and controversial... a happy hunting ground for future geologists. The Devonian conglomerates and volcanics have only a limited outcrop and merit only a couple of pages.

BOOK REVIEWS

The Carboniferous is the most economically important period in the district and is dealt with in greatest detail. I particularly enjoyed the description of the conditions of deposition which brought me up to date the current thinking on the environment of the time. There is a helpful one-page summary chart for the Carboniferous as a whole... why have so many of the names changed since I learnt them all? Several cross sections are given, which show the variations within the various groups throughout the district and these are very useful. Unfortunately, the Coal Measures are poorly served in this respect. There is a figure showing the main lithostratigraphical units, but I would have preferred to see much more detailed figures, given the enormous importance of the Coal Measures.

Intrusive igneous rocks include part of the Distinkhorn plutonic complex and various dykes, sills and plugs dating from Devonian to Tertiary. I would personally have preferred to see the Clyde Plateau lavas dealt with along with the intrusive rocks, so that the links between the two could be dealt with more clearly. The chapter on structure sets the district within the structural setting of the Midland Valley as a whole, but the figure showing principal faults within the district omits any throw values, which is a pity.

The Quaternary of the district is a fascinating account, well told in this memoir. I was gripped by the unfolding story of glacier advance and retreat, formation of buried valleys and Lake Clydeside, glacial drainage valleys and meltwater deposits. The final melting of the ice, colonisation by trees, sea-level fluctuations and peat formation tells a tale of climate change and sea-level rise that has great relevance today.

I found the chapter on economic geology a bit thin. Coal exploitation has been of such vast importance in the district that I thought it would have merited more than just three paragraphs. Some indication of the numbers of pits opened, volumes of coal worked, men employed and a feel for the rise and fall of the industry would have been welcome. The rate of current and likely future opencast extraction would also have been good to know. I did like the reference in the groundwater section to "... the Trumpeter's well near Calderbank, so called because Covenanters put a Trumpeter from the Dragoons into the well. The water from the bedrock is of variable quality..." Not surprising in the circumstances!

The final chapter deals with geophysics, which I found heavy going, maybe due to my lack of knowledge of the jargon and acronyms. A cross section showing interpretation of the deep geology of the district would have been most helpful in demonstrating the results of the geophysics.

BOOK REVIEWS

The memoir is well-illustrated throughout and I like the use of colour to highlight features on many of the figures. I also like the frequent use of six- and eight-figure grid references for exposures of interest, which will help readers who want to go and see the geology for themselves. Unfortunately, the high price of £35 may put many 'weekend geologists' off and this would be a great pity. I very much enjoyed this memoir, which is a very worthwhile acquisition for professional and amateur geologists alike.

GEOLOGY OF THE HAMILTON DISTRICT

I B Paterson, A D McAdam and K A T MacPherson

Memoir for the 1:50,000 Geological Sheet 23W (Scotland)

The Stationery Office 1998. viii, 94pp. £35

ISBN 0 11 884533 0

Paul Carter is an engineering geologist, who has worked in the west of Scotland for much of his working life. He was for some years editor of the *British Geologist* and is currently a consultant to Babbie Geotechnical, Glasgow.

WHISKY ON THE ROCKS

Ian Basham

This, the most recent of the BGS Earthwise publications, is the most original in concept so far in that a tour of malt whisky distilleries and the sources of the water used in their production processes acts as a vehicle for a fresh and entertaining introduction to the geology of Scotland. In the familiar soft cover, perfect bound, 21x20cm. format, its seventy two attractively laid out pages are lavishly illustrated with over a hundred watercolours, commissioned specifically for the project. The BGS has again used 'guest' authors although, after the success of the joint series with Scottish Natural Heritage, it seems surprising to find an account of Scottish geology not authored by members of the Edinburgh staff. Of course this may reflect policy based on costs (the price is very competitive at £6.50) but alternatively does it suggest unexpected abstemiousness in Murchison House?

An introduction defining whisky and describing the production process is followed by a short account of the nature, movement and mode of distribution of groundwater as a source for distillation and cooling. The book is then divided into five chapters based on geological 'blocks' which also conveniently enable grouping of the distilleries more or less according to the traditional 'regions'. The inference is that the geology, through the water, affects the character of the malts. The chapters are:

BOOK REVIEWS

The Argyll Islands (Islay and Jura and their malts); The Grampian Highlands (Highland Boundary Fault to the Great Glen – Speyside, Keith and Elgin, West Highland, Perthshire malts); The Far North (The Old Red Sandstone – Northern Highland and Orkney malts); The Deep South (The Midland Valley – Lowland, Campbeltown and some South Highland malts); The Wild West (Tertiary Volcanics – Western Island and Bushmills!!). The significance of the last three chapter titles escapes me but they seem to have an unnecessarily North American connotation, not entirely savoury.

For the geology, the scheme works well. Concepts and processes are introduced and broad regional patterns established in language that should enable the non-geologist to gain a reasonable understanding, helped by a useful glossary of geological terms. The ‘tours’ of the distilleries are accompanied by accounts of many local geological features but many other interesting scenic, environmental or historical items are also included and illustrated. Chapters are introduced by attractive use of satellite imagery, sketch maps and geological sections and concluded with quite beautifully painted regional panoramas. Well-chosen geological or scenic links between chapters and frequent cross-referencing maintains a feeling of continuity throughout. The page layout is attractive, blocks of text never too long too become tedious and interspersed with Richard Bell’s excellent watercolours.

Turning to the whiskies, the source of water for each distillery is placed within the geological framework and comments made on softness, mineral content etc. Not all distilleries are included, as claimed. Among the omissions, notable are Glen Garioch and Convalmore, the latter rather surprisingly as it would complete the cited ‘seven stills of Dufftown’ and also as mention is made of the site of its water source, the Conval Hills. One of the stated aims of the book “*to lift the curtain*” on the “*effects of different types of water on the final product*” is not really achieved to any extent. No pattern emerges relating the differing character of the whiskies to variations in the water sources. Regional characteristics are not brought out except for Islay and, to a lesser degree, Campbeltown, but even here the treatment lacks objectivity. The well-known phenolic, pungent flavour of most Islay malts is noted and the influence of the island’s peat and waters discussed. However, no mention is made of the profound influence of the salty/seaweed atmosphere which penetrates the porosity of the casks during the long period of maturation.

Another example of unevenness of detail, possibly even bias, is the neglect of the fact that, although Glenfiddich and its sister distillery, Balvenie, are markedly different malts, they both draw their process waters from the Robbie Dhu springs. (Note that Balvenie is not and has not been closed!). This pair of whiskies is perhaps

BOOK REVIEWS

the best example of the relative contribution to the final character made by the malting, distillation and maturation processes compared with the intrinsic properties of the water. Analysis* has shown that minute amounts of as many as five hundred different (organic) molecules are present in matured whisky. Many of these form through a complex series of chemical interactions, involving cask wood, during maturation. Influenced by a number of factors including the nature of the cask, the local microclimate, storage conditions in bond etc. they are accepted as making the dominant contribution to the final unique flavour. One has only to sample and compare the raw spirit from the still with that drawn from the cask after maturation to appreciate this.

The necessarily brief, often perfunctory descriptions of individual malts are not uniformly discriminatory and will prove of limited value as an introduction to their enjoyment. No guidance is given to help the newcomer select a range of typical malts for sampling in order to establish personal preferences. For example, the fairly average Fettercairn merits the description "*all too-easily drinkable, light malt*" while the great Macallan is dismissed only as "*sweet*". What of its unique nose, colour and notable sherry flavour? Comments are likewise absent for several of the 'classic' malts including Balvenie, Clyneleish, Cragganmore, Glenfarclas, Highland Park and Talisker.

In spite of these reservations, perhaps by an over-critical malt lover, this book represents excellent value for money. It contains a wealth of information on Scottish geology, whisky and other topics of interest to the traveller. It is superbly illustrated and attractively presented. Although it is not clear for whom it is really intended (geologist, whisky drinker or tourist) I hope it will find its niche among the ever-increasing selection of whisky books to be found in Scottish booksellers and tourist outlets.

* "Mysteries of the malt", Julie Johnson. New Scientist; 26 January 1991, pp 56-59.

WHISKY ON THE ROCKS - ORIGINS OF THE 'WATER OF LIFE'

Stephen and Julie Cribb

Earthwise Publications 1998. 72pp. £6.50

ISBN 0 85272 290 7

Ian Basham was, until recently, on the staff of the British Geological Survey and now lives in the peace and solitude of the Black Isle. He was at one time Honorary Treasurer of the Society but also has a passion for the Water of Life, as witnessed by his impressive collection of whisky miniatures.

FOSSILS: THE STORY OF LIFE

Fiona Owen

The study of fossils and the evolution of life is a subject that has fascinated geologists, geographers and biologists of all ages for many years. School geography and biology departments dabble in the study of fossils and life history in their Standard Grade or Short Course curricular content, and the imminence of 'Higher Still' offers an even greater scope for the inclusion of this topic into relevant units of work.

This book provides an excellent, 'user-friendly' resource for students of all ages. Almost every question a student might ask about fossils, evolution, earth history or the 'Ice Age' is succinctly yet clearly answered in this book.

The text is well set out in short, simple paragraphs, which guide the reader to well drawn, clearly labelled maps and diagrams. The book deals particularly with British examples, outlining a variety of case studies from specific areas such as 'The Fate of a Jurassic Forest' to 'The Temperature of the Sea'.

It is refreshing to find a text that provides such an in-depth, yet simply, presented resource to students studying biology, geography or geology in the school curriculum... or indeed, any other interested party with a thirst for knowledge for fossils, British stratigraphy and the evolution of life.

FOSSILS: THE STORY OF LIFE

Sue Rigby

British Geological Survey, NERC 1997 64pp. £6.50

ISBN 0 852722 84 2

Fiona Owen is a Teacher of Geography at Lasswade High School Centre. She has also taught geology at O-level and Higher grade in evening classes at Boroughmuir. Indeed, she may well have taught some of the amateur members of our Society.



Proceedings

Proceedings of the Edinburgh Geological Society for the 163rd Session 1996-1997 No. 27

Membership:

Total membership on 30th September 1997 was 557, a slight increase from last year (548), in the following categories:

Honorary Fellows	8 (6)	Senior Fellows	23 (21)
Corresponding Fellows	11 (6)	Family Fellows	32 (33)
Life Fellows	20 (21)	Glasgow Associates	9 (7)
Ordinary Fellows	449 (450)	Junior Associates	5 (4)

Newly elected Corresponding Fellows are **Prof. Ian Dalziel** of the University of Texas, Austin, **Emeritus Prof. Dennis R Dean** of Evanston, Illinois, **Prof. Robert H Dott** of the University of Wisconsin, **Dr. A D Stewart** of Porchiano del Monte, Italy and **Prof. Brian A Sturt** of the Geological Survey of Norway.

Prof. Gordon Y Craig, **Mr. David C Greig** and **Dr. Charles D Waterston** were elected to Honorary Fellowship.

With great regret, we record the deaths of three fellows: **Mike Smith**, who was a member of Council, secretary of the Lothian and Borders Regionally Important Geological Sites (RIGS) Group, and represented the Society on the Scottish Wildlife Trust, **Ian Forsyth**, who was formerly on the staff of the British Geological Survey and **Sir Malcolm Brown**, a former Director of the Survey.

Proceedings

Council, elected on 20th November 1996, was as follows:

President	David H Land
Vice-presidents	A Caroline Paterson and John H Hull
Secretary	J Michael Dean
Treasurer	David Gould
Assistant secretary	C Graham Smith
Lectures secretary	Donald I J Mallick
Excursions secretary	A David McAdam
Membership secretary	Emrys R Phillips*
Librarian	W Barrie Heptonstall
Scientific editors	Philip Stone and Peter G Hill
Proceedings editor	Andrew J Highton
Publication sales officer	Averil H Smith
Lothian and Borders RIGS rep.	Michael C Smith
Ordinary members of Council	Matthew Armstrong, William J Baird, Peter M Dryburgh, R Angus Harkness, Keith I R Halley and Mary M Leitch*
Trustees (not on Council)	P McL Donald Duff, W D Ian Rolfe and William G W Harper
Auditor	Mrs. M McLeod

*During the year, Dr. Phillips demitted office and Mrs. Leitch became Membership secretary.

Proceedings

Lecture meetings were held as follows:

- 9th October 1996 **Prof. G Herries Davies** The problem of valleys - lessons from a bygone controversy.
- 23rd October **Mr. A McKirdy** Conserving our heritage of rocks, fossils and landforms.
- 6th November **Dr. P D Clarkson** Mineral resource potential of Antarctica - the geological realities.
- 20th November **Dr. P C Richards** The oil geology of the Falkland Islands. This lecture was followed by the annual general meeting.
- 4th December **Dr. R W England** Sedimentary basin development in northern Scotland and the evolution of the North Atlantic margin.
- 8th January 1997 **Mr. D Land** Characters and controversies (presidential address).
- 22nd January **Dr. W A Ashcroft** North Sea seismic reflection investigations in oil exploration.
- 5th February Fellows' night.
- 19th February **Dr. W D I Rolfe** My life with extinct arthropods.
Dr. Rolfe was presented with the Clough Medal at this meeting.
- 5th March **Mr. M Culshaw** Earthquakes, planning and engineering - have we got it right?
- 19th March **Dr. R C Scrivener** Henry de la Beche.

Proceedings

Field meetings were held as follows:

26th April 1997	Mr. M A E Browne Rumbling Bridge area
10th May	Mrs. A Smith and Dr D G Woodhall Goat and Orrock Quarries
17th-24th May	Dr. J Roberts and Dr. P Wilson Donegal
31st May	Dr. W D I Rolfe Hagshaw Hills Inlier
4th June	Mr. R W Gatliff Joppa shore
11th June	Mr. D Land Middleton Quarry
18th June	Mr. J Doherty Grangemouth Oil Refinery
21st June	Dr. J R Mendum Aberfoyle and Loch Katrine
25th June	Mr. R Reekie Above Edinburgh streets
20th July	Mr. A A McMillan and Mr W J Baird Dolphinton and West Linton
23rd August	Dr. D Stephenson and Dr. D Millward St. Abb's Head
7th September	R Garton and Mr. M A E Browne Stirling building stones
27th September	Dr. M C Akhurst Shawhead and Crockettford

Proceedings

Scottish Journal of Geology: Volume 32 part 2 and Volume 33 part 1 were published during this session.

James Hutton: During the Hutton–Lyell Conference on 5th – 8th August, a memorial plaque to James Hutton was unveiled on the site of his house at St. John's Hill, and Society members led excursions to Holyrood Park, Glen Tilt, Siccar Point and Kinnordy House. Norman Butcher mounted an associated display in the Central Library.

Scottish Geology Week (10th – 17th August) and Edinburgh Science Festival (22nd March – 7th April): Several members led excursions and presented talks, with the number of participants varying between 4 and 50.

FOREGS: At the meeting of Directors of European Geological Surveys, the president led an excursion to Holyrood Park.

Billet: A new design for the billet, letterheads, etc was prepared by Caroline Paterson, and met with strong approval.

Clough Medal and Award: The Clough Medal was awarded to Dr. W.D.I. Rolfe for his contributions, mainly palaeontological and stratigraphical, to the understanding of Scottish geology, and particularly for his work on fossil arthropods. The Clough Award was given to Dr. P.B. Wignall for his research into the sequence stratigraphy of the Pennines.

Accounts: The summary for the year ending 30th November 1997 follows this report.

EDINBURGH GEOLOGICAL SOCIETY

REVENUE ACCOUNTS FOR THE YEAR ENDED 30th SEPTEMBER 1997

	General	Publications	Clough	Mykura	Total	
	£	£	£	£	1997 £	1996 £
<u>INCOME</u>						
Gross income from investments	1,504	929	604	173	3,210	3,689
Net gain on disposal of investments	(44)	(27)	(18)	(5)	(94)	309
Bank interest	200	124	80	23	427	321
Subscriptions	5,713	-	-	-	5,713	5,818
Tax recoverable on Deeds of Covenant	541	-	-	-	541	566
Legacies and donations	1,010	-	-	-	1,010	2,726
Grants for publications	-	2,414	-	-	2,414	4,359
Miscellaneous	-	6	-	-	6	8
Sale of publications	-	3,241	-	-	3,241	2,050
<u>TOTAL INCOME</u>	8,924	6,687	666	191	16,468	19,486
<u>EXPENDITURE</u>						
<u>Administrative Costs</u>						
Printing, stationery, postage	319	40	-	-	359	126
Insurance	270	-	-	-	270	266
Bank charges	513	-	-	-	513	468
Reception	58	-	-	-	58	38
Miscellaneous	189	-	-	-	189	25
Auditor's remuneration	550	-	-	-	550	575
Depreciation	305	-	-	-	305	244
	2,204	40	-	-	2,244	1,742
<u>Direct Charitable Activities</u>						
Lecture costs	1,428	-	-	-	1,428	1,225
Celebrity lecture	-	-	-	-	-	261
Billets	1,387	-	-	-	1,387	1,498
Award and medal expenses	-	-	223	-	223	216
Excursions	1,269	-	-	-	1,269	668
Scottish Journal of Geology	-	1,500	-	-	1,500	1,500
'Edinburgh Geologist (including Proceedings)	-	649	-	-	649	816
'Discovering Edinburgh's Volcano'	-	-	-	-	-	4,859
Hutton Plaque and leaflet	1,371	249	-	-	1,620	
Grants made	-	-	250	440	690	750
	5,455	2,398	473	440	8,766	11,793
<u>Cost of Publications Sold</u>	-	4,897	-	-	4,897	1,679
<u>TOTAL EXPENDITURE</u>	7,659	7,335	473	440	15,907	15,214
<u>SURPLUS (DEFICIT) for year</u>	1,265	(648)	193	(249)	561	4,632

EDINBURGH GEOLOGICAL SOCIETY

BALANCE SHEET AT 30th SEPTEMBER 1997

	<u>1997</u>		<u>1996</u>	
	£	£	£	£
<u>FIXED ASSETS</u>				
Investments at market value		78,284		67,762
Tangible		726		736
		<u>79,010</u>		<u>68,498</u>
<u>CURRENT ASSETS</u>				
Stock of publications	21,429		25,201	
Other stocks	163		217	
Debtors and prepayments	155		278	
Taxation recoverable	274		328	
Bank accounts	10,016		12,485	
	<u>32,037</u>		<u>38,509</u>	
Less:				
<u>CREDITORS DUE WITHIN ONE YEAR</u>				
Sundry	966		8,053	
Scottish Journal of Geology Vol. 33	1,500		1,500	
	<u>2,466</u>		<u>9,553</u>	
<u>NET CURRENT ASSETS</u>		29,571		28,956
<u>NET ASSETS</u>		<u>108,581</u>		<u>97,454</u>
<u>REPRESENTING</u>				
<u>FUNDS</u>				
Permanent endowment		56,721		51,808
Unrestricted		51,860		45,646
		<u>108,581</u>		<u>97,454</u>

Approved on behalf of Council on 19th November 1997 by David Gould, Treasurer.

THE EDINBURGH GEOLOGIST

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ISSN 0265-7244