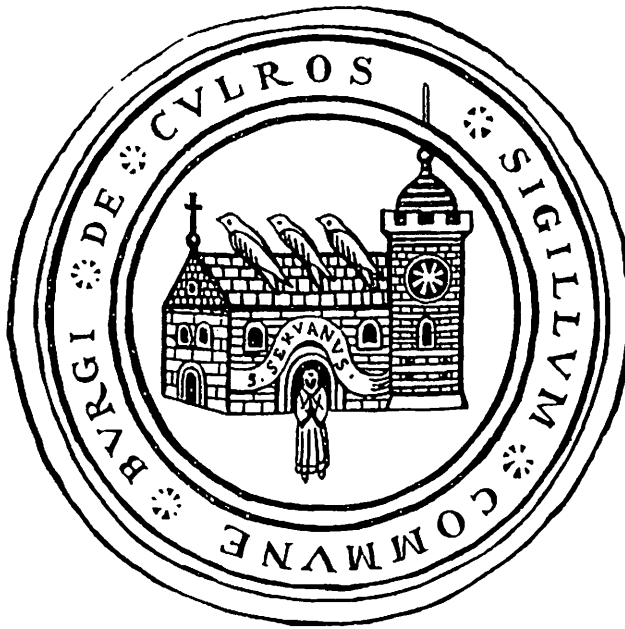
The Edinburgh Geologist



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Cover Illustration

Artist's impression of the ancient seal of the Royal Burgh of Culross, Fife, depicting the church of St Serf.

Acknowledgments

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Editorial

Welcome to the twenty ninth issue of the Edinburgh Geologist. In the lead article, Dr Alan McKirdy reviews the role of Scottish Natural Heritage in geological conservation and its role in bringing geology into public awareness. Created in 1991 through the amalgamation of the much criticised Nature Conservancy Council with other special interest bodies, Scottish Natural Heritage has championed the cause of conservation and sympathetic land management in Scotland. We must applaud the efforts of Alan and his group at 'EH6' for their dedication and far sightedness in raising the profile of the earth sciences, more so than any other public organisation, seat of academia or learned society. Dissemination of information is found at all levels, but always is aimed at educating the public. Hence we find explanatory information boards at tourist points close to sites of geological interest, for example at Assynt. The series of booklets *A Landscape Fashioned By Geology* (reviewed in Issue 28), is an innovative presentation of the geological history behind Scotland's present day landscape. While a more ambitious review of our geological heritage (mostly in the form of SSSI's) is currently being undertaken, and published in the *Geological Conservation Review* series. SNH has also recently produced earth science information packs specifically aimed at modules in the current school curriculum. On the conservation front, we can all contribute by supporting our own local RIGS groups. Through apathy, neglect and ignorance we are likely to lose our natural heritage, thus the work of SNH deserves all our support.

Turning to our other contributions. David Land outlines the history of underground coal mining at Culross and the unique contribution of Sir George Bruce. After some delay, we present Nicholas Kidd's article on his unique and important discovery of amphibian remains in the Cheese Bay Shrimp Bed. Bill Baird looks at some of the myths and misnomers in Scottish gemology, and the efforts of Brian Jackson at the Royal Scottish Museum to critically examine Scotland's gem heritage. Bill also pops up later on with two contrasting articles in his *Strange Earth* series. The first examines cranial devlopment through time, while 'The Gibralatar Waterfall' charts the possible history of incursion from the Atlantic Ocean into the Mediterranean basin and the destruction of the land-bridge between north Africa and Europe. With Spring and the new field season ahead of us, David McMahon offers some advice to would-be excursion leaders. While there is a light hearted review of past Society excursions by David McAdam. With the average age of Society's membership increasing and recruitment/retention of younger people at an all time low, Keith Halley paints an interesting picture of life in the 'Edinburgh Geological Society'. Hugh Barron presents a résumé of Simon Conway Morris' fascinating account of Cambrian life in the Burgess Shale at a joint meeting of the Edinburgh and Glasgow Societies. Finally, a little teaser handed to me by Stuart Munro, courtesy of R Melville Thompson. Maybe I should have titled it 'Heap of the Day'!!

THE ROLE OF SCOTTISH NATURAL HERITAGE IN THE CONSERVATION OF OUR ROCKS, FOSSILS AND LANDFORMS

Alan McKirdy

Scottish Natural Heritage (SNH) have a duty in law to protect our heritage of rocks, fossils and landforms. Many nationally and internationally important sites are designated as Sites of Special Scientific Interest (SSSIs) and there is a requirement for any development proposal affecting these sites to be considered by SNH. This does not guarantee that development will not take place within SSSIs, but this mechanism does mean that the conservation arguments are weighed in the balance before planning decisions are made.

The Geological Conservation Review

Key geological and geomorphological sites have been identified throughout Britain. Descriptions of these localities are currently being published by Chapman and Hall as part of the *Geological Conservation Review* series. This series of volumes is an important public record of the sites considered worthy of conservation throughout Britain. The full listing of volumes published to date in the GCR series is as follows:

1. An Introductory Volume to the GCR
2. Quaternary of Wales
3. Caledonian Structures in Britain South of the Midland Valley
4. British Tertiary Volcanic Province
5. Igneous Rocks of Southwest England
6. Quaternary of Scotland
7. Quaternary of the Thames
8. Marine Permian of England
9. Palaeozoic Palaeobotany of Great Britain
10. Fossil Reptiles of Great Britain
11. British Upper Carboniferous Stratigraphy

Plans have been made to complete publication of the remaining titles in the series by the year 2000. The GCR series will consist of 6 volumes on Palaeozoic stratigraphy; 7 volumes on Mesozoic-Cenozoic stratigraphy; 4 volumes on structural and metamorphic geology; 5 volumes on igneous petrology and mineralogy; 6 volumes on palaeontology; 7 volumes on Quaternary geology and geomorphology; 4 volumes on "active process" geomorphology.

The recently-published *Introductory Volume to the Geological Conservation Review* provides the rationale for site selection of SSSIs, particularly the criteria used in defining the individual site networks. The main site selection criteria are as follows:

- sites of importance to the *international* scientific community
- sites containing *exceptional* features
- sites of national importance as they are *representative* of events or processes.

In addition, a series of guidelines has been established to consider whether

- there should be minimum duplication between sites
- proposed sites should have a long history of research
- proposed sites should have potential for future study
- proposed sites should be capable of conservation

Fostering an Understanding of the Natural Heritage of Scotland

"Geology and geomorphology underpin many of the properties that give the landscape its scenic quality - and remember the natural beauty of the countryside is one of the biggest assets of the tourist industry. The rocks not only influence the kinds of plants, animals and insects that we find in every part of the countryside, but also shapes the lives and livelihoods of the human community that live there." These words were written by Magnus Magnesson, KBE, Chairman of SNH, and they highlight one of our key tasks.

Our founding legislation, the Natural Heritage (Scotland) Act 1991 requires that SNH should "foster an understanding of the natural heritage of Scotland." However, the Earth sciences have yet to capture the public's imagination. It is considered by many as too academic and perhaps even irrelevant, as it draws on evidence for events that took place many millions of years ago. Making the case for the conservation of a Caledonian pine wood or a rare mountain habitat is, by comparison, more straight-forward, as there is an implicit understanding of the need to preserve such features. However, we are working hard to increase public awareness of the need to conserve our heritage of rocks, fossils and landforms through a series of initiatives.

A Landscape Fashioned by Geology

The *Landscape Fashioned by Geology* series, published in association with the British Geological Survey, tells the story of landscape evolution without the use of technical language. Sharing the subject with a wider audience undoubtedly assists the process of garnering support for the conservation of our Earth's heritage. Five titles have been produced to date in this series - *Edinburgh, Skye, Cairngorms, Loch Lomond to Stirling and Orkney & Shetland* and publication of *East Lothian and the Borders* is imminent. Other titles are in preparation at present and it is hoped that within the next few years a total of around twelve booklets will have been published,

sold either individually or as a boxed set. Each title is already selling at the rate of around two thousand copies per year, despite limited marketing. This demonstrates that there is an audience for publications on the Earth sciences, if the information is attractively presented. We are indebted to the many contributors from BGS who have worked on this series.

Advances - A Resource for Teachers

Scientists in Scotland have an enviable reputation for research. However, many of the advances in the Earth science field remain locked away in the scientific literature, too inaccessible for working teachers to lay hands on. In addition, some topics which are already in the curriculum, such as soils, are poorly supported by resource material. SNH has produced a series of posters and associated teacher's notes which aims to capture recent scientific advances in the fields of terrane tectonics, soil biodiversity and soils in relation to land use. An inter-active CD ROM has also been developed to accompany the terrane tectonics poster and teacher's notes, which demonstrates the movement of Scotland across the globe and the associated plate movements. Further titles in the *Advances* series are currently in preparation.

Regionally Important Geological/geomorphological Sites or RIGS

A greater public awareness of the need to conserve the best of our local features is clearly important and the RIGS initiative has done a great deal to achieve that objective. RIGS groups are active in Lothian & Borders, Tayside, Fife and Highland. Conservation of local sites by local people has been taking place throughout Scotland for the last four years and if you would like to join any of the groups, then please contact us at the address below and we will put you in touch with the local organiser.

Scottish Geology Week

Following the excellent example set in Wales and Northern Ireland, Scottish Geology Week, seven days of lectures, guided walks and museum exhibitions is planned for August of next year. Our objective is to organise a hundred events throughout the length and breadth of Scotland for the benefit of local residents and visitors. Members of the Edinburgh Geological Society will undoubtedly play a very prominent role in *Scottish Geology Week* and will help to carry the message far and wide. Chevron Oil plc have agreed to sponsor the event. If you want more information or would like to become involved in any capacity, please contact Judith Grimshaw at SNH, 2 Anderson Place, Edinburgh EH5 6NP

CULROSS MOAT SHAFT: A SCOTTISH 'FIRST' IN MINING TECHNOLOGY

David Land

Most Society members will have visited Culross on the Firth of Forth and seen Sir George Bruce's house, the so-called 'palace', built in 1597 and enlarged in 1611 (Sked, 1985). The wealth which enabled him to build his palatial home came from coal mining and its companion industry of salt panning. Culross, where there were some 50 salt pans, had a thriving sea-borne trade in salt and coal with eastern Scotland and the continent, especially through the port of Veere in the Netherlands.

Strata cropping out at and around Culross belong to the Upper Limestone Group of Namurian (mid-Carboniferous) age, and consist mainly of mudstones and sandstones with some limestones and coal seams, arranged in repeated cyclic sequences, as may be seen in exposures on the foreshore at Culross (Haldane and Allan, 1931). About the middle of the group is the Jenny Pate or Janet Peat Coal which was a seam mined near Culross, where it is 7 to 9 feet thick, with some mudstone partings. It correlates with the Upper Hirst Seam which is currently being worked in Longannet Colliery to the west. Around Culross, superimposed on a general westerly dip, the strata are disposed in a SW trending anticline-syncline pair (Figure 1 - the Jenny Pate Coal is labelled JOC).

Early coal workings, by the Cistercian monks of Culross Abbey, were near outcrop and limited in depth to about 30 feet because of drainage difficulties. In 1575 coal mining was taken over by Sir George Bruce who personally managed the work with energy and enterprise. His success brought such prosperity for himself and the town that thirteen years later King James VI made Culross a Royal Burgh (Sked, 1985). There where mines near the shore at and east of the town, but Bruce's showpiece colliery was Blairburn, west of Culross near St Serf's Church (Haldane and Allan, 1931).

Problems in mining arise mainly from difficulties with drainage and ventilation. Bruce dealt with the former with his 'Egyptian Wheel' pump which was powered by horses and comprised an endless chain carrying buckets, operating on the principle of a modern bucket dredger. This device allowed the mine to be taken to a depth of 240 feet.

As the mine extended, ventilation became a problem. In those days, before the advent of forced ventilation by fan (the first in Scotland being in 1827 at Paisley), mines had to rely on natural ventilation. It was therefore common practice to connect the workings to surface by sinking and raising additional shafts. With

extension of the Culross Colliery workings southwards beyond the high tide mark, an ordinary ventilation shaft became impossible. Bruce solved the problem here in a most daring and innovative way. The Moat Shaft was sunk from a rock reef on the foreshore [NS 9805 8540], fully a quarter of a mile seaward of the high tide line. The depth was said to be 40 feet. The poet John Taylor visited Culross and his 'The Pennyless Pilgrimage' described the shaft as 'a circular frame of stone, very thick, strong, and joined with bituminous matter, so high withal that the sea at the highest flood, or the greatest rage of storm or tempest, can neither dissolve the stones so well compacted in the building, nor yet overflow the height of it' (Taylor, 1618). He also adds ' I did never see, read or hear of any work of man that might parallel or be equivalent with this unfellowed (unique) and unmatchable work' (quoted in the first Statistical Account of Scotland). Taylor's eulogy is well merited, for this construction in about 1604 of an off-shore shaft rising through an artificial island represents a Scottish 'first' in mining technology which was not repeated elsewhere for some 200 years, when the Valleyfield Moat Shaft [NS 998 857] was constructed half a mile ESE of Culross.

This sort of shaft has, of course, its dangers from the fury of the seas, and notwithstanding Taylor's optimistic statement, Bruce's shaft was destroyed in a storm in 1625, the same year in which he died.

Preston Island Shaft [NT 007 852] should also be mentioned (Figure 1). This 19th century work served the same purpose as the Moat Shaft, but being on a natural island it is not in the same league of engineering daring as the earlier shaft.

Nowadays undersea workings are commonplace and extensive, but ventilated by fans in on-shore shafts or adits. Valleyfield colliery, for example, was connected to Kinneil, four miles across the Forth. Colliery workings extend several miles off-shore near Kirkcaldy and up to seven miles in Northumberland. There is also several miles of undersea railway tunnels such as the 33.5 mile Seikan tunnel linking Honshu and Hokkaido in Japan, and the slightly shorter Channel tunnel.

Taylor rightly thought very highly of Bruce's shaft, on his visit in 1618; but King James VI saw matters differently on his visit to the mine that same year. Having entered near St Serf's Church, they emerged at the Moat Shaft at high tide. Seeing himself surrounded by the sea the king panicked, crying 'Treason'; but Bruce assured him of his safety, invited hm aboard a waiting ship, and soon had the king safely at dinner in 'the palace'.

This article will hopefully draw attention to the innovatory aspect of Bruce's work, which so far as I am aware has neither been mentioned in print nor emulated in

practice anywhere else in the world. I believe that this is a Scottish first of to be justly proud of and which deserves wider recognition and acknowledgement.

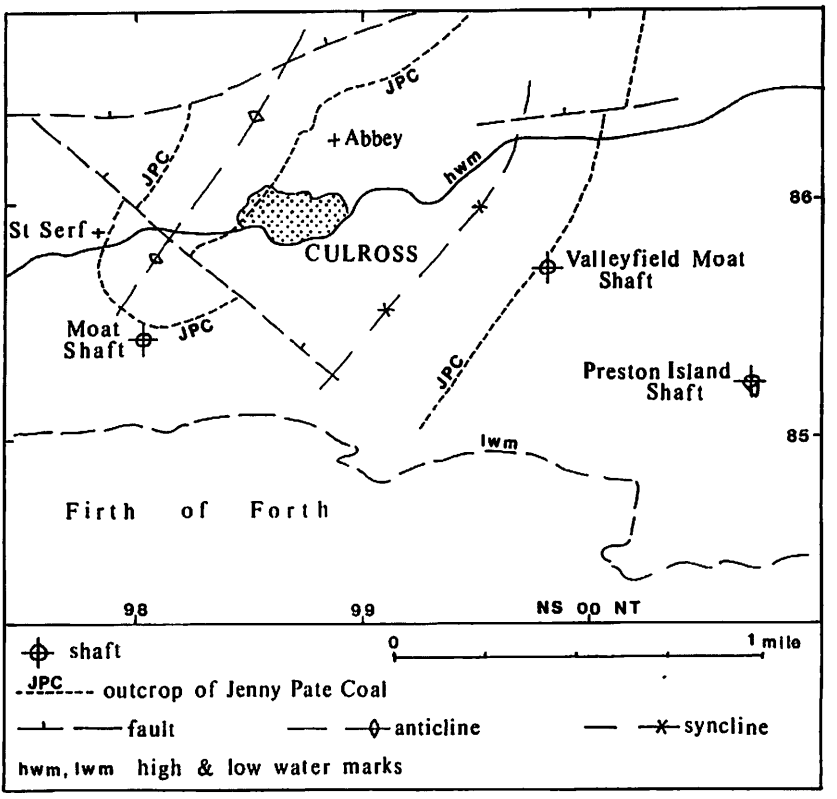

Figure 1. Location of the Moat and other shafts in the Culross area.

Acknowledgements

I am most grateful to my colleagues Mike Browne and Ian Hogarth for help and constructive criticism in compiling this account.

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AN AMPHIBIAN FROM THE CHEESE BAY SHRIMP BED, GULLANE, EAST LOTHIAN

Nicholas Kidd

Since the discovery of the Cheese Bay Shrimp Bed early this century, the fossil fauna it has yielded consists mainly of the crustacean *Tealliocaris* and rarer fish elements (Hesselbo and Trewin, 1984). Now for the first time the remains of an amphibian have been found. 'Scampi', as the specimen has been nicknamed, was recovered from a weathered block found loose 50 metres from the actual shrimp bed outcrop. Although the skull is missing (with the exception of what is thought to be the impression of the posterior end of the lower jaw), 'Scampi' is an important find, being older than the famous East Kirkton amphibians (*c.* 338 Ma) and of comparable age to the enigmatic Wardie amphibian, *Lethiscus stocki* (*c.* 345 Ma). Unlike *Lethiscus*, 'Scampi' is thought to have been a terrestrial animal, making it one of the earliest such tetrapods found in any semblance of completeness.

The specimen was exposed by splitting the block in two, revealing distinct fossil bones on block A (Figure 1), whereas block B revealed the impression of block A material with the addition of the rear portion of the animal. Unfortunately this part has been partially eroded thus making details indistinct, pending further preparation. On block A the ribs, vertebrae, five-toed fore-foot and large belly scales are beautifully preserved. The wrist bones are not ossified unlike those of the East Kirkton amphibians. The rear limbs, tail and pelvic material of the amphibian are preserved on block B.

Measuring approximately 6.5 cm along the 23 or so vertebrae from the neck to the pelvic region, 'Scampi' lay in unit C of Briggs and Clarkson's (1985) 12cm thick laminated dolomite shrimp bed. Sadly the bed itself is now so poorly accessible that most collecting is done from rare lose blocks found on the foreshore.

'Scampi' was viewed for the first time in October 1991 by the staff of the Royal Museum of Scotland, where it generated considerable excitement. A cursory examination revealed the specimen to be an extraordinary find. The specimen has since been viewed independently by Dr A.R.Milner of Birkbeck College, London, and Dr J.A. Clack of the University Museum of Zoology, Cambridge; both leading palaeontologists working on the East Kirkton amphibians. Each responded with enthusiastic interest for the specimen, regarding as almost certainly a new species. Following a full description, it is hoped that 'Scampi' will shed some more light on the evolution of the amphibians.

Figure 1. Front part of 'Scampi' on block A

Having had the humbling experience of finding 'Scampi' and being its custodian, I would like to think that its resting place will not be far away from that magical little place called Cheese Bay.

Acknowledgements

I would like to thank Dr R.L. Paton (RMS) for her generous help and advice. Also thanks must go to Bill Baird (RMS) who suggested writing the above article, and G.A. Kidd and A. Bird, my companions on the day 'Scampi' was found.

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SCOTTISH GEMS

Bill Baird

Scotland's complex geological past has created many sources from which gem material might be derived. In rocks of either intrusive or extrusive igneous origin, gem material occurs as a minor constituent; the agate-bearing Old Red Sandstone lavas and the pegmatite veins within the Cairngorm granites spring immediately to mind.

It is not surprising that most geologists are familiar with Scotland's wealth of semi precious stones. Scottish agates are world famous for their delicacy of colour and wonderful variety making them treasured by lapidaries and collectors alike. The sherry coloured cairngorm provides a classic cut stone for setting in a brooch or on the haft of a Skean dhu, and Scottish ones are highly sought after. However, fewer geologists are familiar with the more classic gem types, which also occur in Scotland. In fact many are unaware of their existence, although the mention of Elie rubies will normally prompt the reply "but are those not garnets?". This is surprising as a brief trawl through the literature, including the Geological Memoirs of the Cairngorms, will produce several references to beryl and topaz. It is when we come to examine some of these references that we begin to realise that many are simply rehashes of earlier articles and even old newspaper reports.

The practice of authors repeating old information about Scottish gems and gem localities is probably because they have nothing new to report. The reasons for this are related to the geographical remoteness of many locations. Even if a writer did take the trouble to make a journey to a location in the central Cairngorms, he might not then necessarily have the knowledge or expertise to find and recognise gem quality material. Perhaps, like a visit made by the present author, he might find the site under snow even in July. It is also noticeable that some modern collectors are very cagey about the location of new finds; "somewhere in the Cairngorms", is a fairly loosely defined location.

By taking just one example from historical reports we can see how circular and repetitive they are, each later one feeding to some extent on the previous. The Coulnakyle Beryl was found *c.* 1840 by a woman who became nicknamed as "Caileach-nan-Clach" (Old woman of the stone) because she searched for gem stones deep in the Cairngorms. It was bought by a Mr Winsloe then residing at a place called Coulnakyle, hence the name. The present location of the stone is unknown, but its existence is recorded in many magazine articles and books about the Cairngorms, even those whose subject is little to do with the geology or natural history of the place.

The finding of very large cairngorms appears quite often in the literature of the Cairngorms. For example a cairngorm crystal measuring 20 inches in length and weighing 49lbs is recorded as having been found near the top of Ben Avon in 1788. During Victorian times many fortune hunters climbed the Cairngorms' lonely summits hoping to discover a giant cairngorm or another Coulnakyle beryl. Surprisingly, some did succeed and many stones were found and sent mainly to Aberdeen to be cut. However, they were never easy to find and weather conditions could become Arctic even in the summer. Only the toughest could survive digging trenches in the scree filled hollows of the granite, sleeping in a crude stone bothy and eating a monotonous diet of oatmeal and water. Quite soon the best localities were worked out and the final death blow came when much cheaper stones began to be imported.

Thus what is the truth about Scottish gemstones? There are of course no diamonds, or are there? John Smith believed he had found diamonds in the graphite from Craigman near New Cumnock. However, his physical determination of the material was not conclusive and the specimens themselves can no longer be found. Heddle believed that small diamonds occurred three miles north east of Ben Hope, but again, where is the evidence? The application of better exploratory techniques and an improved ability to examine offshore deposits continues to tempt the geological fraternity to extend the search for diamonds.

Despite all the mysteries, missing specimens and, perhaps, wishful thinking, Scottish gems do exist and new finds have been made recently. Groups of keen amateur and professional gemmologists have been successful in discovering new localities for gem rough and extending the range of faceted gem species. Some of these localities have been outside the main Cairngorm granite massif, normally regarded as the source area for most cutting quality material. The finding of sapphires in a camptonite dyke on Lewis in the Outer Hebrides showed the possibility of sources in some of Scotland's deep origin igneous outcrops. Discovery of gem quality tourmaline in pegmatite float at Glen Bucket, Aberdeenshire also showed that stones can be found even when the source rock from which they were derived is not exposed.

Several such stones have been expertly cut and added to the collections of the National Museums of Scotland. Brian Jackson, gemmologist with the Royal Museum of Scotland, and I have seen other gems, mainly beryl and topaz, either cut or in the natural crystal form which shows that beautiful gems can still be found. I recently sat enthralled as one of Scotland's most experienced and perhaps determined mineral collectors showed me the results of a recent discovery. He carefully unwrapped some of his finds, reputedly taken from a fissure in the granite

somewhere in the Cairngorms. The last specimen unwrapped was a gem quality beryl as long and thick as your index finger and of perfect smooth crystal structure.

So to summarise: gem rough can still be found, but is rare and you are unlikely to make your fortune seeking it. This is doubly true because even should you find a crystal it may not necessarily be suitable for cutting and the cost of faceting a good quality gem could be prohibitive, possibly even more than the stone is worth. In either case foreign imports are still going to be much cheaper than any Scottish finds and, one should be prepared to pay a high price for items with this provenance.

Brian Jackson and a team of gemmologists are seeking not just to find new stones and new localities but also to recover part of Scotland's gem heritage. Where are those famous and much written of stones of the past: the Counakyle beryl and the huge cairngorms? What of the many stones that must have been cut into gems both from the Cairngorms and other sources? Brian has tried to seek information from his colleagues in other museums with little success. He has also tried to trace the families recorded as being linked with Scottish gems, again to little avail. However, it is probable that a few of these stones are still around incognito. Is it possible that great great granny's brooch handed down from mother to daughter for over a hundred years does really contain a Cairngorm beryl? It would be easy to dismiss such a story as a bit of wishful thinking but a delve into the family history might produce some connection with the old gem seekers of the Cairngorms. Obviously we cannot identify every stone in old pieces of Scottish jewellery. However, if significant circumstances warrant it, Brian Jackson would be delighted to examine and comment on any gems thought to have a Scottish provenance and a history linking them the old days of the Scottish gem trade. At this very moment part of our Scottish heritage may be resting in an old jewellery box unrecognised, a long lost treasure of our gem stone history.

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HOW TO LEAD A FIELD EXCURSION

David McMahon

In the theatre, it is always easier to give advice from the security of the gallery than to be on the stage acting and these notes are by way of being a voice from the gallery, illuminated I hope, by experience. They are born of many years participation in excursions both as a face in the crowd and as a leader. I hope that they will not offend good leaders, of whom there are many, by appearing to teach them how to suck eggs and that they will be helpful to those wishing to improve their skills. They refer to the time spent in the field and do not take into consideration the complexities of organising transport, accommodation, food etc.

Aims

Your aim must be to make a pleasant event of demonstrating some aspect(s) of geology in the field so that it will be fixed in the participants' minds and that they will recall the occasion with pleasure.

An excursion must have a good atmosphere; it should be friendly and casual, and this is largely the creation of the leader. There is a time to talk and a time to encourage others to do so and a time to be silent and enjoy the atmosphere of a locality. Leading any party requires you to be conspicuous (not bossy!). Members of the group should never be asking who (or where) the leader is. It is important that the atmosphere is not that of an obedient school party (unless it is a school party!).

At the end of the excursion, the participants should have a feeling of achievement - they should feel that they have seen and understood the things which you set out to demonstrate and they should also feel the pleasure which a walk in the countryside gives (unless of course the locality is one such as Sunderland town dump where the geology is excellent but the environment is slightly less than perfect!)

Preparation

It is essential that a good leader is fully prepared before going into the field. Make sure that you understand the geology which you are going to demonstrate and, whenever possible, have appropriate maps and notes prepared to hand out in advance and/or in the field, as appropriate. Wherever possible, you should visit the locality shortly before the day of the excursion so that there will be no unpleasant surprises on the day. For example, the magnificent exposure you saw ten years ago in the town dump may have since been obliterated by refuse. You will get little

sympathy from the group if, when you arrive at the site you say in hesitant tones "I'm sure it was here ten years ago and it was the best example in the country; or was it at the other refuse dump eight miles away?" There is nothing more disappointing than this for members of the party and embarrassing for you. Make sure that you have obtained all necessary permissions for entry from landowners and occupiers and that they know the date and time of your proposed visit. Carefully read and follow the Code for Geological Field Work issued by the Geologist's Association. The Code of Practice for Geological Visits to Quarries, Mines and Caves, issued by the Institute of Geologists, is especially useful for such localities.

In preparing for the excursion, do not limit yourself to geology. Find out as much as possible about the area you will visit and the route you will follow. Cover history, wild life, farming practices, interesting/historic buildings etc. This will add to the interest of the excursion and will encourage the participants to find out more for themselves. Always try to discover beforehand if specialists in relevant subjects, e.g. botany, archaeology, local history, ornithology will be present and, if appropriate, ask them if they are willing to help by talking about their subject as it comes up in the course of the excursion.

The day of the excursion

Don't just start walking. Before setting off, assemble everyone. Make sure they can hear what you are going to say, then state what the objectives of the excursion are, describe the geology, mention any other features that may be of interest and distribute hand-outs as appropriate. If you have experts present who have volunteered their services, ask them to identify themselves to the party so that they can deal with questions. In presenting the geology, you may have explained the route but if not, be sure to do so. Say where you start and finish, indicate the type of terrain, distance to be covered and the likely duration of the excursion. Try to keep reasonably to your stated timetable and route. It is a besetting sin of enthusiastic leaders that they lose track of both and go on so much further and longer than originally stated that the less resilient members of the group are exhausted by the end and perhaps they will be put off geology for ever, presumably not one of your objectives.

Check that everyone has the appropriate and necessary equipment. If this is not so, quietly draw it to the attention of those concerned. Gucci handbags and stiletto heels (seen on an uninhabited island in Greenland!) come into this class. If you believe that people might be put at risk, you must advise them not to come on the excursion. If they insist on doing so, indicate clearly that you cannot accept responsibility for them.

Manage the pace of the group by setting a reasonable one. Be sure that it will not tire the slower members of the party. Too fast a pace will create large gaps in the group thereby promoting clusters of people and slowing even further those who are behind. Too slow a rate can build impatience and boredom. Set your pace from that of the slowest person in the party. If necessary, ask such people to walk immediately behind you so that you can encourage and keep an eye on them.

Stay in the lead. Before setting off, ask members of the party not to go ahead of you. By being in front, not only can you control the pace, but you will be able to see stopping places far enough in advance to group the party in the best way. Always walk with the group - not a quarter of a mile ahead which would putting physical and mental pressure on those at the back. Keep a close watch on those at the back and see that they do not straggle. Before the excursion begins, it is a good idea to appoint a back marker who will bring up the rear of the group and check for stragglers.

Keep a head count. On short excursions where it is difficult to lose members of the party the need for a head count is minimal, but, on longer ones, and especially in rough and wild terrain, they become essential and the consequences of someone becoming lost can be very serious indeed. Always make it clear to the whole group that if someone wants to leave the party, they must tell you before they do so and it is preferable that they do not go off alone, especially in remote or rugged country. Keep an eye on those at the back and look backwards as often as forwards. Keep in touch with the back marker appointed at the beginning of the excursion and if he/she shows signs of finding the task tiresome, find a replacement.

Rest stops should be spaced at reasonable intervals often determined by the pace of the slower members of the group. Some but not all rest stops can be timed for geological localities. Always tell the party why you are stopping (study, coffee break, lunch break, comfort stop or just rest)and say for how long. Shopping should be firmly discouraged (even for ice cream!). It is notoriously difficult to re-form a group once some of its members have disappeared into a shop. If this disaster threatens, or has overtaken you, plan on recovery taking at least fifteen or twenty minutes. Proper preparation can often allow you to select rest stops which coincide with geological or other interesting localities. Don't forget that those at the back are probably the most tired. Don't let those at the front have a good rest only to start the party walking again as those at the rear catch up. If you have information to impart at a rest stop wait until every member of the party has arrived before you begin. At a meal or snack stop always advise people ten minutes before you intend to set off.

When you arrive at a locality, always wait until all of the party has arrived and arrange them and yourself so that they can hear what is being said. When speaking,

be sure that you are upwind so that you can be heard clearly. Never attempt to talk to the group as a whole while walking. Your voice will be carried away and only those near you will be able to hear. This also applies at localities where you may be tempted to look towards the rock or view whilst talking and this also makes for inaudibility. Remember that if you are near running water or breaking waves your voice may be entirely drowned. Speak loudly enough and adjust the volume of your voice to the size of the group. A bellow calculated to reach the back of an amphitheatre containing six hundred people is hard to take in a group of six. Likewise, a gentle conversational tone perfect for half a dozen won't quite make it with sixty. An observant leader will be able to tell when those at the back can't hear. There will be tilted heads, strained facial expressions and strained positions. Monitor the group for feedback of all kinds; in this way most difficulties can be overcome before they develop. For the benefit of the entire group repeat all questions addressed to you. Frequently, those speaking to you will do so in a voice which doesn't carry and your reply will be meaningless to those who didn't hear the question. Not only will this practice keep the entire group informed but it will remind those who might take unfair advantage and monopolise the activity that you have a responsibility to all and can't provide a private talk.

Be careful not to discourage your audience with unnecessary jargon. Before you use such a word, ask yourself if its use is necessary and think how you might convey your meaning plainly. If you must use an expression that might be unfamiliar, don't say "of course you all know what a thanatocoenosis is" or worse still, "hands up all those who don't know what a thanatocoenosis is." Instead, say something such as "perhaps I should remind you what a thanatocoenosis is." The reaction is likely to be nodding heads and smiles of varying degrees of sheepishness.

When you have finished describing things of interest and have dealt with questions from the group, indicate that they may now examine the exposure. Always discourage aimless hammering and where appropriate, forbid it altogether. Draw attention to any appropriate safety precautions such as care for self and others when hammering, hazard from loose rock and falls from exposed positions. Ask that individuals do not move off as soon as they have finished examining the locality but that they wait till everyone is ready go and that you are again in the lead. Always make sure that the entire group moves off at the same time, otherwise those making an extensive inspection of the locality will have to struggle to catch up and the net effect is that a wildly straggling group develops.

Provide visibility. A group's viewpoint is different from the leader's. Features on or near the ground are difficult to show to a large group because only the closest can get a good view. When dealing with a big group, try to limit yourself to features which are large enough to be seen easily. This is not always possible and in such

cases, encourage the members to form a large circle or semi-circle so as to improve viewing. When all else fails and it is essential for all to see a small feature, divide the party into several groups and repeat your presentation to each one. Be especially sure that children and small people can see. Their perspective is different from the leader's and from that of tall people. Invite them to step to the front. Taller people will be able to see over them. Wherever possible, try to place the group down wind of you and with their backs to the sun.

Look for opportune moments. No matter how exhaustive your planning, there will always be moments when the unexpected happens. Be flexible and alert to use them. If a small ash cone suddenly begins to erupt in an adjacent field, do not gnash your teeth at this unwarranted interruption and doggedly pursue your description of the petrography of greywackes. Seize the opportunity and interpret the serendipitous happening. Now is the time to mention Plinian eruptions and the present as the key to the past, and not at the coal merchant's yard in the next village where you planned to demonstrate the angle of repose and the formation of cones. A skilful leader can alter the pace and incorporate the unexpected into his presentation without a break.

Encourage responsible participation. Urge members of the party not to take your word for it but to examine the locality and find out for themselves. Uncontrolled, this can lead to aimless hammering and substantial damage to the locality. Watch for early signs of this and quietly but firmly discourage it. At many localities study needs little or no hammering and if specimens are required the best ones are often found in loose material round the site.

Good planning produces the best results. If the route takes you past an ancient monument or a disused limekiln, take along a sketch or photograph of it and describe the uses of it parts.

Be ready to deal with emergencies. Heart attacks, asthma episodes, sprains, attacks of vertigo, hypothermia, bruises and simple exhaustion can sometimes be compounded by heat or cold. All of these can and do happen. Be prepared to deal with them. Carry a basic first aid book and be familiar with its contents as well as having emergency equipment appropriate to the circumstances of the excursion. Consider contingency plans to cover emergencies. A member of the party may have to be sent for help or act as a leader to take charge while you stay with the ill or injured person. You will have to decide what is best course of action in the circumstances of the occasion. Whatever happens, there is no excuse for having failed to plan ahead and for not knowing enough about first aid to be able to take emergency action. A first aid kit is not bulky and should always be carried in the field.

Follow the Codes of Practice for geologists and others in the field. Be sure that you understand them and that the understanding is passed to the members of the group. Always use gates and stiles to cross fences, hedges and walls. Protect wildlife, plants and trees. Take your litter home. Keep to public paths across farm land (particularly in standing crops make sure that your group walks in single file). Ensure that all closed gates are re-fastened after the group has passed through (liaison with the back marker is essential here). Make no unnecessary noise. Guard against risk of fire especially in dry weather.

Don't let the party disintegrate limply at the end of the excursion. Bring the proceedings to a well defined close. Summarise what has been demonstrated, remind people of any unexpected interesting moments and thank them for attending.

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I am pleased to thank Caroline Paterson for her helpful comments and advice.

'THE EDINBURGH GEOLOGICAL SOCIETY'

Keith Halley

When the Edinburgh Geological Society was formed, William IV was on the British throne: Charles Darwin was making his epoch-making voyage in the Beagle; the railways were just making their appearance; and Sir Walter Scott was scarcely cold in his grave...

With a pedigree going back very nearly to the pioneering days of Hutton and Lyell (both local men who are today recognised as founders of modern geology), the surprising thing about the Society today is that it is remarkably unstuffy. In fact, it's more than that. Whilst drawing on the very considerable geological expertise of the Grant Institute of Geology, the University of Edinburgh, and nearby Murchison House, the Scottish Office of the British Geological Survey, the EGS goes out of its way to welcome and encourage any one - amateur and professional - to become involved in its programme of lectures and excursions.

The primary requirement for anyone wishing to become a Fellow of the Edinburgh Geological Society is that he or she should have a professed interest in geology. It is that interest which, since the Society was founded in 1834, has brought together some of the most brilliant geological minds in Scotland and some of the most enthusiastic amateurs, together with their husbands and wives. It is this cheerful blend of expertise and enthusiasm, coupled with the geological variety of the Scottish landscape, which brings an extra dimension to the Society's regular excursions to sites of geological interest throughout Scotland. Even the North of England is within relatively easy reach of Edinburgh, and has been visited on occasions!

Lecture meetings are held throughout the winter, usually fortnightly, in the Grant Instititute on the Kings Buildings site, a short drive or bus ride from the City Centre. Such is the prestige of the Society, there is normally no difficulty in attracting speakers of the highest calibre, many of whom travel to Scotland from throughout the United Kingdom for the sole purpose of addressing the Society. Apart from being open to Fellows of the Society, the lectures - which are always well attended - are free of charge, and open to students and members of the public. The subjects offered vary widely. This season, those covered include topics as varied as ikaite (a mineral which has the disconcerting habit of disappearing once it has been recovered from its natural setting), plate tectonics, Cambrian life, platinum in the Pacific, and the geology of the Hindu Kush. Annually the Society bestows its

Clough Medal on an eminent field geologist, who is then invited to address the Society.

The summer excursions are equally varied. With the Midland Valley, the Southern Uplands, and the Central Highlands all within easy reach of Edinburgh, there is no shortage of geological localities to be explored. These include some of the "classic areas of British geology" - such as the Arthur's Seat volcano in the centre of Edinburgh, the fossiliferous sites of Dura Den in Fife and Dob's Linn near Moffat, and, of course, Hutton's famous locality at Siccar Point, on the Berwickshire coast. Traditionally, the relevant extracts from Hutton's paper on Siccar Point, laying the foundations of knowledge about unconformities and the age of the Earth, together with Playfair's account of their first visit by boat, are reverently read aloud whenever the site is included in a Society excursion. Excursions take place, usually at intervals of two or three weeks throughout the summer. Wednesday evening excursions during June take advantage of the long summer evenings to explore the local geology. Each year a 'long excursion' travels further afield to the Scottish Highlands and islands, such as Orkney, Shetland and Skye. Last year it was the Isle of Man and in 1996 Islay.

The Edinburgh Science Festival now has an established place each April in the City's calendar. The Society plays a major role by running successful excursions to Arthur's Seat. Also in bringing geology before the public, the Society has: marked the site of Agassiz Rock ('This is the work of ice') by a notice in the Hermitage of Braid in Edinburgh; established an information board in the City's Princes Street Gardens describing the glaciation of the Castle Rock volcanic plug; commemorated Clough at Birkhill Station near the cutting in which he was fatally injured by a train in the now private railway; and preserved the visitor book at the Inchnadamph Hotel inscribed by the many eminent geologists who attended the 1912 meeting on the Moine Thrust held there.

In 1997 the Edinburgh Geological Society will be closely associated with an International Geological Conference being held to celebrate the bicentenaries of James Hutton (died 1797) and Charles Lyell (born 1797). It is being run jointly by The Geological Society in London (30 July - 3 August) and by the Royal Society of Edinburgh (5 - 9 August).

Subscriptions to the Society are a modest £12 per year, which includes the lectures, subsidised excursions and the Scottish Journal of Geology. There are reductions for Family, student and junior members. Contact Mr Mike Dean, Honorary Secretary, Edinburgh Geological Society, 6 Correnie Gardens, Edinburgh, EH10 6DG, for further information.

LONG EXCURSIONS 1976-1995

David McAdam

From small beginnings on Rum in 1977, twenty annual long excursions have now been held by the Society in May. A feature of these has been the gathering on the last evening, with reflections on the week and, since 1983, the award of the Strontian Hammer. This implement, found rusting on a beach, and now restored and decorated, is awarded (in the opinion of the panel, usually AA McMillan and W F Baird) to the person whose contributions have been beyond the call of duty. Below is a list of all 20 excursions, together with the recipients of the Strontian Hammer, a roll which (together with the two named above) does honour to many of the people most-involved in the long excursions over the years. I also present two contributions from the most recent excursion to Islay, which give a flavour of the long excursions and, hopefully, may encourage more Fellows to take part in future years.

		Award winner			
1980	Islay		1987	Rogart	J Laxton
1981	Skye		1988	Shetland	D Gould
1977	Rum		1989	Beauly	D Gould
1978	Assynt		1990	Rum	K Oakley
1979	Mull		1991	Orkney	S M Ross
1982	Arran		1992	Skye	A R MacGregor
1983	Strontian	W Mykura	1993	Assynt	D R Shelley
1984	Balmacara	A D McAdam	1994	Mull	R E Garton
1985	Kylesku	F May	1995	Isle of Man	A C Paterson
1986	Dalavich	S I Hogarth	1996	Islay	M M Rusbridge

Islay Song - sung to "A'wandering"

Chorus

Here's the sun, oh it's gone,
here's the rain
We are getting wetter,
Here's the sun, here's the rain
My feet are wet **again**.

1. We love to go a-wandering
with
Our leaders on the track,
And as we go we love to sing
"Graham, please come back!"

2. David G's been here before
He thinks he'll show the way,
He always goes the long way
round
To everyones' dismay.

3. We gather round the outcrop
At our leader's call,
"Can you just repeat that please?
I didn't catch it all"

4. It's the Dalradian that we seek
But was it an illusion?
That the feeling of the week
Was an absence of
conclusion.

R Garton and others

Verses on Islay 1996
(Apologies to McGonagall)
Best read (in column order) after a large Islay malt whisky

In nineteen hundred and sixty six
The E.G.S. on Islay did fix
For its May week ex-cur-si-on
With lots of Fellows there-up-on

But where to go said our Caroline
The central town of Bowmore would be
fine
Two Inns flats are down by the shore
And Douglas House would give us three
more.

In nineteen hundred and eighty, Wally
Did land our party on its sally
To each and every part of Islay
But who today would lead the way?

Our Caroline looking for a name
Was told about the Survey's Graham
Who, armed with piles of scientific
papers
Ably led our geological capers.

Our navigator found the shortest way
To take us to Kilchiaran Bay
Phyllite and Grit of the Colonsay Group
As along the beach we all did troop.

Chatter marks and glacial striae
Preceded the trip to Sannaigmore Bay
Long and hard raged the argument
Was it fluvial or turbidite sediment.

On the way back home to the flat
Graham wanted to demonstrate to us that
The glacial story still was obscure
Outwash or moraine, no one was sure.

Rain, rain, was the Tuesday menu
Back to the flats was the dominant view
Some decided to just put up their feet
For others the distillery was a rare treat

We travelled by two white minibuses
Arnold Clark had kindly hired us
Driven by Graham and Caroline,
Tom, Ros, and Mike, too, would do fine.

We set off promptly last Saturday
And first met up at Inver-ar-ay
To Kennacraig in a great old hurry
We sey off to catch the CalMac ferry.

Port Askaig was our landing place
Where Islay showed her sunny face
Then off we set to see Bowmore
And see what Caroline had in store.

Unpacked, provisioned, fed and watered,
One minibus to Port Ellen sortied
We still had time ere came the night
To see the sills in the Port Ellen Phyllite.

On the Sabbath, to expurgate our sins
We were all taken to the Rhinns
Complex-ity of rocks it seems
Awaits geologists at Port Wemyss.

Portnahaven and Lossit Bay
Gave us hint of the awful way
The Islay weather would with us tease
Sun, shower, calm, wind or breeze.

Monday saw us back at the Rhins
Seemed we still had to pay for our sins
Down to the shore at Octofad
Seeing a contact cannot be bad.

To Mulreesh to see the lead mine
No, Finlaggan would do us fine
Then back to Mulreesh, where
More mineralisation was there.

Despite the forecast weather that day
Two took the boat to Colonsay
While the Port Askaig tillite
For many was the week's highlight.

Set fair, the 'Isle of Gigha'
Took our minibuses on to Jura
To Lussa Bay to see Jura Quartzite,
The Scarba Conglomerate, too, was a sight.

How soon came round our last day
Port Ellen was on the way
To the American Monument on the Oa
It had seemed along way to go.

Lunch at Kilnaughton, in the sun
Our travels still were not yet done
Port Ellen, Laphroaig, Lagavulin,
Ardbeg
Four distilleries pass by, stop! we beg.

Cnoc Rhonastil's differentiated Tertiary
boss
Must be viewed ere Kildalton's Cross
Graham and Sinclair put us right
This is the Shore Leucodiorite.
Our week is almost at an end
Graham, our ears throughout did bend
But Islay's geology now is clear
To the E.G.S. party this very year.

THE OTHER SIDE OF 1996 EXCURSIONS

Kenneth Aitken

Why do I go on Edinburgh Geological Society excursions?:
1. Picturing the dim and distant past through the rocks excites me.
2. I need the exercise.
3. Saturday's TV is boring.

But seriously, I have a lot of fun getting roasted, drenched, sprayed with sea water and wet feet. What other activity offers such a variety of potential discomforts as an EGS excursion? But I love it!

To start the 1996 programme, we took off to see the quarries near Ratho. I enjoyed wearing my red Scottish Aggregates hard hat at Bonnington Mains Quarry. It is the only time I have promoted a company for my own personal safety. The striations on the rock above the quarry, showing where the Quaternary ice sheet had been, were impressive. Pity they are destined to be excavated away next year.

Next came the excursion to Bail Hill and Afton Water. On Bail Hill, seeing the sparse Ordovician volcanic exposures and being able to draw so many conclusions about island arc subduction was remarkable. Walking up Afton Water was also remarkable, because it took me back to my time in school choir, when we sang "Flow Gently Sweet Afton" by Robert Burns. Looking at the incredible greywackes along the river, I could not get the song out of my head.

The following trip was to the Strathblane Hills and Dumgoyne, where, unfortunately, the weather took a turn for the worse. As the rain started and gradually got heavier, we squelched up Alvain Burn and admired the massive Campsie Fell lava flows. But then it got icy cold and the clouds descended, ruining our plan to climb the Fells themselves. After a brief respite of sunshine, we scuttled between clumps of trees during the downpour, catching a glimpse of an exposure from time to time.

The Wednesday evening excursions were each a unique experience. As usual, I revelled in the geology of the familiar and the unfamiliar rocks.

Climbing Lion's Haunch vent of Arthurs Seat was a mountaineering feat -
I clearly need fitness training before I try it again.

Howden Burn was a guessing game: name the Lower Devonian altered rock.
To get the right answer without cheating, all you need is a chemistry lab.

Broadlaw Quarry and adjacent exposures were fascinating. Seeing the fool's gold glinting in the Ordovician Broadlaw Granite was a tremendous pleasure. It prepared me for the real challenge of the evening -escaping the midges.

My main memory from the Blackford Hill excursion, apart from the magnificent andesite and trachyte rocks and the Agassiz monument, was one of our party following the Scotland and England European Cup matches on a small transistor radio. He kept us posted with every Scotland and England goal.

The next excursion was to St Andrews and St Monans. Among the fascinating volcanic exposures near St Andrews, we saw the only type of bomb that does not require disposal experts - a geological one. This one looked as if it had just landed - splat! - into jelly or suchlike. Yet it was set into solid rock and was some 300 million years old.

The Bavelaw Silurian inlier excursion took place on a sultry, scorching day. We all had to slap on lots of sun cream and drink gallons of water to keep going. The gorge through which Logan Burn ran was wonderful, both because of its Lower Devonian conglomerate and because it was the only piece of shade for miles around.

At Eyemouth we scrambled over wave-cut platforms to see Devonian sandstone and agglomerate in the morning and climbed around rocky peninsulas and ravines to see Silurian greywackes in the afternoon. But hearing about the Herring Queen of Eyemouth really interested me. The idea could well catch on. In the EGS, we could have a similar event - the Quartz Dolerite Queen, perhaps.

The final excursion of 1996 was to Kinnoull Hill and Campsie Linn near Perth. At Corsiehill Quarry on Kinnoull Hill, we saw where a dyke used to be, before it went to pave Perth's roads. Then we moved on to a working quarry at Dunsinan which excavated andesite. While being shown inside a rock crushing plant there, we all did a rerun of the Hitchcock movie, Vertigo. This was because we could see the floor of the plant, one hundred feet below us, through the see-through platform that we stood on.

At Campsie Linn, a wide quartz dolerite dyke straddles the River Tay. There we saw some canoeists. One, in particular, seemed to be doing his best to imitate a submarine. His entire canoe was under water as he paddled, but no, he did not sink. Why he didn't is a mystery to me.

At the end of this season of lively excursions, I wonder .... what new rocks and surprises are in store for 1997? Perhaps, next year, someone will find the answer to the ultimate geological question: Why are the best specimens always attached to the biggest rocks??

STRANGE EARTH 16: ENIGMA OF THE BIG BRAIN

Bill Baird

Most people think of the human brain as having gradually increased in size as man developed from primitive ancestors. In general terms this can be accepted as a true statement of the palaeoanthropological evidence. One of our earliest hominid ancestors *Australopithecus afarensis* who lived 3 million years ago had a skull with a brain capacity [brain size] of only 450cc (these figures are sometimes estimates, when they are based on the cranial capacity of reconstructed skull cavities). Some 2 million years ago *Homo habilis* had a brain size of some 750cc. By 1½ million years ago *Homo erectus* had a brain size of some 1000cc and by the time of Swanscombe man 250,000 years ago brain size had grown to 1300cc. Modern man has a brain of some 1280 to 1360cc. In the face of it then, a steady progression. This increase may have been linked to increasing manual dexterity and also perhaps the use of language and increased social interaction. One of the resulting changes in human behaviour has been the increase in the size of the social grouping from a simple family group, to a clan, then to the extended tribe and eventually a nation.

However, like all rules there are exceptions. In the case of human brain size these seem to defy evolutionary theory and in terms of progress lead us in a circle. If we accept that an increase in brain size is necessary for human social and technical skills then it should follow that the larger the brain the more dextrous and socially skilled the owner. How then do we explain the Neanderthals, with an average brain size of 1600cc for males, which is greater than that of modern man? This race, widespread in Europe, the Middle and Near East from over 100,000 to 35,000 years ago seems to be an exception to the rule. They have left little of significance in the way of artifacts, either tools or ornaments. In terms of social skills and ability to operate as a group, larger than that of the extended family, to the advantage of the race, they seem to have been a woeful failure. Cro-magnon man with a slightly smaller brain seems to have absorbed them or destroyed them with little difficulty.

You might think the Neanderthals were a race with other problems, which so hindered evolutionary progress, that the handicaps outweighed the advantage of the big brain. Perhaps there was an unknown handicap, but what if the Neanderthals were not alone in having a larger brain than modern man? What if in South Africa at the end of the last ice age there were a people, the ancestors of the present Bushmen, with huge brains? A few thousand years ago this clearly recognizable modern race had individuals with brain sizes approaching and perhaps sometimes exceeding 2000cc.

It is important here to enter a note of caution. Brain size in modern man is given as an average of just over 1300cc for men and 100cc less for women. But the minimum and maximum are 1000cc to 2000cc. Widely quoted examples of this variation are Anatole France weighing in at 1000cc and Jonathon Swift at double that. Any individual within the minimum and maximum limits can show all the abilities of skill and even genius or be of subnormal mental development. In other words, within a fairly wide range, brain size is not a direct measure of intelligence. The link between brain size and intelligence does exist but it is not absolute. The correlation factor is quoted as 0.3 to 0.35. There is some evidence to suggest that density and network activity within the brain is equally or even more important than absolute size. However, it is obvious that historically a clear indication of human progress is increased brain size linked to dextral and social skills. So when then does a big brain become a handicap? What is the nature of that handicap? How indeed do we measure intelligence? If intelligence tests are set by people of normal brain size, what relevance might they have to an individual with a brain one third bigger than the individual who set the test. It is only 50 years since just such flawed tests, carried out in the USA, proved that the American Negro was mentally incapable of competently flying combat aircraft.

It is interesting to speculate on the significance and uses of larger than normal human brains. If we believe in evolution as a non-reversible process then there must have been some significant advantage, however short term, of the linkage to its continued increase in size.

Imagine an environment where human numbers had not significantly reduced the once huge numbers of edible species of food animals and plants. Where the climate was reasonably kind and the threat of predators, both animal and other humans, was low. Where there was time to ponder on the song and flight of birds, to watch the rising and setting of the sun, moon and stars. To listen to the wind and rain, watch some things grow and others die, to be overwhelmed by the beauty of this wondrous earth with all its riches. It is pleasing to think that these might have been some of the pastimes of our big brained ancestors. However, that time, if it ever existed has gone forever, so where do we go from here? Can we draw any understanding of our present situation and compare it to the lives and thoughts of previous races?

For what it is worth I make a suggestion which I believe has the hallmark of simplicity and practicality. It may be that the increase in brain size was only a benefit when it achieved maximum social conformability with greatest manual dexterity. Anything further was a positive irrelevance. At the optimum stage of racial, national or social groupings the human race can operate almost like the social insects. We can use manual skills to manufacture weapons or dam rivers. We can defend our territories to the death, at the command of an accepted individual or elite. We can create power and circulate it for use throughout a nation. With our size of

brain we can either manage to operate adequately on our own or combine to operate as a super organism like the ants or termites.
With a bigger, more complex brain, I suggest that we become different. We become knowing, questioning and immensely aware of our position in and links with the environment.

Not for nothing does Homo sapiens network computers, set up think tanks and hold group brain storming sessions. We have little to learn from the ants, I believe that we are ourselves becoming a social organism. We should not look back on our ancestors with disdain for their primitive life but forward with apprehension to our façade of a modern life.

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STRANGE EARTH 17: GIBRALTAR WATERFALL

Bill Baird

A large herd of elephants came purposefully down towards the freshwater spring as the evening light began to fade. The scene was reminiscent of the African Rift Valley with its landscape of open plains and, in the distance, the shore line of a huge salt lake. Everywhere there were herds of grazing animals and around their edges prowled hungry predators and scavengers. Away to the west the ground rose into a low ridge and from beyond the ridge came the relentless sound of ocean waves pounding on a beach.

The weather down on the great plains had been unusually warm again as it had been for the last few years. In the late summertime the great salt lake began to shrink and the old shore lines were now miles from where they had been a few decades ago. The freshwater springs continued to flow unabated as they were mainly fed by water from the mountain glaciers that had been melting at an ever increasing rate over the last few years. In the late spring the great herds moved northwards up the slopes out of the great basin following the new grass. As autumn came nearer they moved back down into the basin to their traditional grazing grounds.

This year the sound of the waves pounding on the western ridge had become very noticeable, especially when strong winds blew consistently from the west. On this

particular autumn evening, the strong west wind was accompanied by a low pressure area moving into the gap between the two continents which the ridge connected. Sea level had never been higher and for the first time in millions of years, trickles of water from the highest waves began to find their way through low points on the ridge and flow down its eastern slope. At first the trickles were intermittent and the flow of water was small. However as the wind persisted and massive waves continued to pound onto the beach. One particular spot became eroded by the flow and more sea water started to pour through the breach. Eventually the seawater began to run through the breach even when not driven by the waves. By the time the storm had eased a permanent breach had been made in the ridge. Now each time the wind blew from the west or even when the tide rose, water poured through the breach in a growing river of sea water. On its short eastward journey from the high level Atlantic Ocean to the low lying plains the channel grew wider and more powerful by the day. Descending from the rocky ridge it tore away the soil and soft rocks, forming a cascade that eventually developed into a huge waterfall. Day by day the waterfall grew in volume and width until its thunderous roar disturbed the grazing herds on the plains away.

At first, apart from the noise near the waterfall, the denizens of the great plains noticed little difference. True a new riverhad appeared, running down to the salt lake from the west, but there was little initial change in their life style. By the spring, however, animals whose winter migration pattern took them south of the lake found they could no longer complete their traditional journey north. In their path was a large and powerful salt water river. The salt lake had grown to such an extent that they could no longer go round it to the east. After milling around the water's edge for a few days, the herds turned south to the great mountains of the southern continent. Those to the north of made for their traditional northern grazing grounds, although some smaller groups occupied some nearer areas of high ground. Little did they realise that their age-old pattern of life had been interrupted irretrievably.

Within a few decades this great river running from the Atlantic Ocean would fill the whole basin, bringing the level of the Mediterranean Sea up to that of the worlds other oceans of. No longer would there be a land bridge between Europe and Africa allowing migration between the two continents. Those animals that had made for higher ground now found themselves trapped on newly formed islands as the waters rose. Their descendants would become smaller, in the evolutionary struggle to match body size to a limited environment and food supply.

Evidence for these momentous years is revealed in the great masses of fossils found on the Mediterranean islands. Sometimes, deposits of bones were of such quantity that commercial extraction was possible. The clue as to why the bone assemblages comprised animal groups now mainly known in Africa has only recently come to

light. Drilling programmes in several areas of the Mediterranean have revealed the presence of extensive thick deposits of salt laid down during late Tertiary times. In the Upper Miocene period the Mediterranean, once more, became cut off from the Atlantic Ocean as Africa and Europe collided, closing the straights of Gibraltar. During the following centuries, evaporation exceeded inflow from rivers and the Mediterranean Sea was reduced to a series of large saline lakes occupying only the deepest hollows. Great rivers, such as the Nile and the Rhone, continued to feed these lakes. In so doing, they cut a series of great gorges and deep valleys whose existence had previously mystified bathymetric investigators. Life on the low lying plains surrounding these lakes life soon established a regular pattern, with endemic animals and plants soon colonising the new ground. Cycles of birth and death, migration and movement, became re-established and assumed an air of permanency. This continued for hundreds of thousands of years on the great plains below the western ocean. Now the ocean has returned and the cycle has been completed, with the Mediterranean a sea once again.

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Report on the Edinburgh Geological Society's
James Wright Memorial Lecture 13 March 1996

BURGESS SHALE FAUNAS AND THE EXPLOSION OF CAMBRIAN LIFE

presented by
Professor Simon Conway Morris, FRS
University of Cambridge

Professor Conway Morris was welcomed and introduced by the President of the Edinburgh Geological Society, Dr David Land. Members from both the Edinburgh and Glasgow geological societies made up the audience.

One of the most remarkable events in the history of life is the enormous evolutionary radiation of animals, colloquially known as the Cambrian "explosion". Although most obvious from the sudden appearance of fossil skeletons, it is now clear that this event involved much more than simply the acquisition of hard parts. Prior to this event the first reliable evidence of metazoans in the fossil record are the Ediacaran faunas, which appeared abruptly around 640 Ma (Vendian). These biotas are almost entirely soft-bodied and are known from South Australia, southwest Africa, England, Newfoundland, Scandinavia and Russia. The widespread occurrence and locally abundant preservation of soft-bodied fossils is unusual in comparison to the Phanerozoic where soft-part preservation is sporadic and usually reflects unusual combinations of preservational circumstances such as catastrophic burial or anoxic conditions, or both. An absence of predators and scavengers and the restricted degree of bioturbation during Ediacaran times is the most likely reason for the widespread soft-part preservation. The increasing levels of bioturbation and sediment disturbance during the Phanerozoic may explain why most of the major marine Lagerstätten are confined to the Palaeozoic. The majority of the Ediacaran forms appear to be cnidarians. Stalked forms with an expanded leaf-like body such as *Charnodiscus* invite comparison with the pennatulaceans (sea-pens). Other organisms include a possible annelid worm, arthropod-like forms, and others of unknown affinity. In a reappraisal of the Ediacaran fauna, Seilacher proposed that they represent an entirely separate group, possibly a distinct kingdom.

Whatever the disagreement surrounding the biological affinities of the Ediacaran fauna, it is clear that they lacked skeletal material, the widespread appearance of which heralded the Cambrian Period at around 560 Ma. The advent of abundant skeletal parts composed of calcium carbonate, calcium phosphate or silica, which together provided for the first time in the history of the earth an adequate fossil record. Two major schools of thought exist on the rise of skeletal faunas:

1 *Changes in the physiochemical environment* Close to the Precambrian–Cambrian boundary there is evidence for substantial changes in ocean chemistry, such as stable isotope variations (particularly Sulphur and Carbon) and the widespread episode of phosphogenesis. Major rifting events and the break-up of the late Precambrian supercontinent with the consequent transgression may have also played a part. The extent to which these physical and chemical changes affected evolutionary events is, however, far from clear.

2 *Ecological reasons* Many groups possessed tightly interlocking sclerites or valves that enclosed or allowed retraction of soft parts; these features would seem to be a response to predation. This is also suggested by the marked rise in the variety of trace fossils close to the Vendian–Cambrian boundary which reflects expansion in behavioural patterns such as hunting strategies, methods of locomotion and ability to penetrate substrates. However, trace fossils have the disadvantage that the identity of the maker is seldom revealed, and that similar traces can be made by very different animals.

The magnitude and abundance of the Cambrian explosion is made apparent by the examination of the exceptionally preserved Burgess Shale-type faunas where soft bodied animals account for the great bulk of species and a vast range of animal types are present. Some of them relatively familiar, such as arthropods. Others, however, to our eyes look decidedly strange and seem to pose major problems in evolutionary interpretation.

The richness and diversity of Cambrian life is most vividly expressed in the Burgess Shale and similar deposits from areas such as North Greenland and South China. The spectacular Burgess Shale fauna was discovered by Charles D Walcott in 1909 and in the following ten years or so he collected over 65 000 specimens from the Phyllopod bed, the most prolific source of fossils in the Walcott Quarry, British Columbia. In 1966-7, an expedition led by H B Whittington reopened the quarry. The Burgess Shale (an informal unit in the Stephen Formation) is a Middle Cambrian basinal sequence of mudstone and siltstone that was deposited beside a carbonate reef forming a vertical escarpment. Most of the fauna lived on the mud surface, and in the water column above, at the front of the escarpment. They were overwhelmed by a weak turbidity current of fine sediment and transported a short distance down-slope to probable anaerobic, H_2S-rich environment.

At Walcott quarry the fauna is exceedingly rich and diverse being represented by about 120 genera, mostly monospecific. Twelve major groups are present: arthropods, polychaete annelids, priapulids, sponges, brachiopods, molluscs, hyoliths, echinoderms, cnidarians, chordates, hemichordates and incertae sedis. There is also a flora which includes cyanobacteria, red and green algae and acritarchs. The fauna is dominated by relatively few taxa, some nine species

account for 90 per cent of the total. Arthropods dominate the benthic fauna, but only a small fraction are trilobites. Many of these arthropods have walking appendages preserved. Early examples of the four main arthropod groups (Uniramia, Crustacea, Chelicerata, and Trilobita) are represented. These include *Aysheaia,* a caterpillar-like creature with some resemblance to modern onychophoran *Peripatus* which lives in the jungles of Brazil, and the common *Canadaspis* which is regarded as the earliest positively identified crustacean. But many of the arthropods have no modern relatives e.g. *Opabinia* with its elongated segmented body and five eyes. Other animals include *Pikaia*, a segmented worm-like creature which is probably the earliest chordate, and *Hallucigenia* which is probably an armoured lobopod. The Phyllopod bed also yields a number of pennatulacean-like animals that are similar to some Ediacaran taxa. Evidence for predation in the Burgess Shale fauna comes from mouth parts and gut contents. Entire hyoliths have been found in the gut of *Ottoia* (priapulid worm). Indirect evidence for predation comes from the enigmatic *Wiwaxia* which has a protective coat of sclerites and elongate spines which were presumably used to deter attack.

A locality in North Greenland has recently yielded an exceptional soft-bodied fauna from the Lower Cambrian Buen Formation. The lithologies present, black shale and dolomite are similar to those of the Burgess Shale. Lightly skeletalised arthropods dominate the assemblage, but it also includes polychaete and priapulid worms, sponges, palaeoscolecidans, simple trace fossils, and most significantly, articulated halkieriids. rior to this find halkieriids were known almost entirely from isolated sclerites and from reconstructions taking clues from *Wiwaxia corrugata*, a Middle Cambrian descendant form. The articulated specimens seem to belong to a single species assignable to *Halkeria.* In addition to around 2000 sclerites per specimen, there is a prominent shell at either end of the body. The presence of these shells and the accretionary mode of growth suggest the halkeriids are related to the molluscs and are a possible precursor to the brachiopods. In addition, molecular biology has shown that Brachiopods are surprisingly related to the annelids.

An understanding of the Burgess Shale-type faunas remains of the highest importance. This is for two reasons. First, there seems to be the possibility of tracing at least some of the steps that are involved in the appearance of new "designs" of animals. Second, study of these fossils helps to explain both the origins of the Cambrian "explosion", perhaps genetic, and its subsequent history. This latter aspect seems to have been largely a product of the unfolding ecologies of the Cambrian world, most notably predation. In conclusion, the Burgess Shale-type faunas give a series of insights into the early evolution of animals, the consequences of which are apparent until the present day.

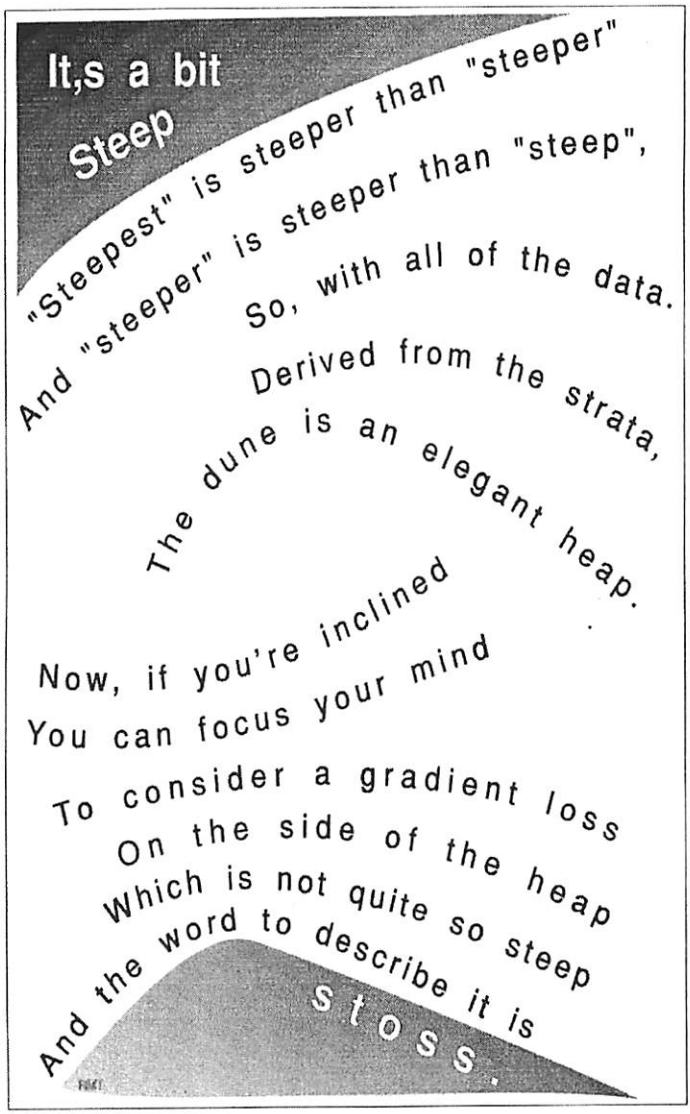
A vote of thanks was given by Dr Euan Clarkson who paid tribute to Professor Conway Morrises skills as a speaker and presenter, particularly his verbal fluency

and excellent slides. He commented on how at least some of the bizarre oddities of the Burgess Shale are now being understood as belonging to more ordinary 'respectable' groups; how in the words of one Swedish geologist 'oddballs from the Cambrian are beginning to get even'. As parting shot, Dr Clarkson left us with the striking visual imagery of bright orange slug-like *Halkeria* creeping across the sea floor and turning into brachiopods by morning!

Hugh Barron

THOUGHT FOR THE DAY?

with thanks to R Melville Thompson



Book Review:

Fife and Angus Geology. A R MacGregor
The Pentland Press £12.50

This **3rd** edition (contrary to the publishers notes) of the Fife and Angus guide brings together the not inconsiderable volume of new work that has been produced since second edition, that went out of print over 10 years ago. Excursions to the Aberdeen-Stonehaven coast and South Queensferry included in previous editions have been omitted; these are now covered by the Aberdeen and Lothian guides respectively. The guide is largely centred on St Andrews, but covers much of Fife and the Angus-Kincardine coast as far north as Stonehaven. However, excursions to Glen Esk and Comrie, although lying outside the nominal area of the guide have been included to broaden the range of geology. Approximately twenty five per cent of the volume is taken up by the *Introduction* and chapters describing the geology of the area, while the remainder is devoted to 18 descriptive itineraries. The *Introduction* comprises sections on geography and general geological settings, the coverage of the guide and further reading. A geological code of conduct and advice on calculating tides (providing you possess a diary which shows phases of the moon) is included. The following five chapters under the headings *Dalradian, Highland Border Complex, Devonian (Old Red Sandstone), Carboniferous* and *Quaternary*, succinctly describe the geology of the area. The Precambrian (and ?Cambrian) rocks of the Dalradian, the Highland Border Complex and Highland Boundary Fault are each covered by two excursions, while the Devonian sedimentary and volcanic rocks are dealt with in five and the Late-Caledonian Comrie Igneous Complex by one. The stratigraphy, structure, lithology and palaeontology of Carboniferous sedimentary rocks are covered by eleven itineraries (five of which include accounts of the contemporaneous volcanic rocks), while the Permo-Carboniferous intrusions figure in another five excursions. The more recent Quaternary fluvioglacial deposits and raised beaches feature in three excursions, only. The itineraries are easy to follow and systematic in their lay-out. Each describes the significance of the excursion and route, with details of relevant 1:50 000 geological and OS maps, walking distance and time, i.e. half- or whole-day excursion. The guide is well illustrated, and includes 23 maps (including one in every itinerary), 6 plates, 7 tables, 20 figures. A number of field sketches by the author adds a welcome personal touch to the book. The broad spectrum of geology ensures something of interest for most tastes. At £12.50 it is excellent value and if you are intending to visit the district the guide is a must. Roy MacGregor is to be congratulated for allowing himself to be 'persuaded ' to undertake this revision.

Graham Smith

Proceedings of the
EDINBURGH
GEOLOGICAL SOCIETY

159th Session
1992-93

No. 23 **November 1996**

INTRODUCTION

This, the twenty second issue of the *Proceedings*, covers the 159th Session 1992-93 of the *Society*.

MEMBERSHIP

Total membership at 30 September 1993 was 557, which represents an increase of five from the 1992 figure of 552 members. The membership comprises as follows:

Honorary Fellows	8 (8)	Senior Fellows	11(12)
Corresponding	8 (8)	Family Fellows	34 (34)
Life Fellows	24 (26)	Glasgow	7 (12)
Ordinary Fellows	429 (445)	Junior	6 (7)

Twenty Ordinary Fellows were elected and 18 re-instated, but losses through death, resignation and removal totalled 54. With regret we have to record the deaths of Russell Lawrie FRSE, Dr Byron Lintern, Professor John Sutton FRS and Dr G A Yarwood.

PUBLICATIONS

Volume 29, part 1, of the Scottish Journal of Geology was published, and part 2 was *in press* by the end of the session. Trade subscriptions to the Journal totalled 266, with a world-wide clientele. The guide book ***Scottish Borders Geology*** was published by Scottish Academic Press. The editors and most of the contributors are fellows of the Society.

CLOUGH AND MYKURA FUNDS

The Clough Medal was awarded to Dr Euan N K Clarkson FRSE for his researches in Lower Palaeozoic palaeontology; and the biennial Award was bestowed on Dr J Andrews for his contribution to sedimentological studies in Scotland. Grants were made from the Clough Fund for work on saurian footprints and from the Mykura Fund to support field studies in SW Scotland.

LECTURE MEETINGS

The following open meetings were held during the session:

7 October 1992
Recent developments in Lake District geology
Dr F Moseley
21 October
Stereo-oblique aerial photography - a down to earth approach for environmental and geological problem solving
Mr D Fisher
4 November
By pick and by creel - a survey of early mining techniques
Rosalind Garton
18 November
The Kola super-deep borehole, Arctic Russia - geology, geophysics and drilling techniques
Dr C Gillen
This lecture was followed by the Annual General Meeting
9 December
Basin inversion
Professor M Coward
13 January 1993
Palaeoclimates
Dr D Kroon
27 January
Granite and crustal evolution
Professor C Hawkesworth
17 February
Fellows' Evening
3 March
Lower Palaeozoic history of the Midland Valley of Scotland and Ireland
Dr E N K Clarkson (following the presentation of the Clough Medal)
17 March
River sedimentation, placers and environmental changes in the tropics
Professor M Thomas

RECORD OF FIELD EXCURSIONS

24 April 1993	Scottish Mining Museum, Newtongrange Rosalind Garton
8 May	Gargunnock Burn Dr W Read
12 May	Comiston sand pit and Agassiz Rock Mr M Smith and Mr J Merritt
15-22 May	Assynt Mr S M Ross and Dr A R Macgregor
12 June	Ballantrae Dr P Stone
16 June	Torphin Quarry and Torduff Hill Dr A McKirdy and Mr D Land
3 July	Blairgowrie area Dr T P Fletcher
28 August	Bedshiel, Raecleuch Head and Whiteadder Water Mr I B Cameron and Mr A D McAdam
11 September	Kircudbright coast Dr R F Cheeney
18 September	Birkhill (Clough memorial excursion) Mr D Land and Professor G S Boulton

COUNCIL

Following nominations at the AGM on the 18 November, the elected members of Council for the session were:

President	Professor G S Boulton FRS, FRSE
Vice-presidents	Mr D H Land and Dr E N K Clarkson FRSE
Secretary	Dr R F Cheeney
Treasurer	Dr D Gould
Assistant Secretary	Dr C G Smith

Membership Secretary	Mr J W Merritt
Excursion Secretary	Mr J K Oakley
Meeting Secretary	Mr J A Fairhurst
Librarian	Dr W B Heptonstall
Publications Sales Officer	Mrs C M Taylor
Edinburgh Geologist and Proceedings Editor	Mr C A Auton
Ordinary Members	Mr R D Gillies, Dr A J Highton, Miss A H Hope, Miss H McHaffie, Mr A G Sutherland and Dr J R Underhill
SWT representative, co-opted	Mr M C Smith
Office-bearers not on Council	
Trustees	Professor G Y Craig, FRSE, Dr C D Waterston, FRSE and Professor P McL D Duff, FRSE
Scientific editors[1]	Dr B C Lintern[2], Dr D Stephenson and Dr R F Cheeney
Auditor	Mrs M McLeod

[1] With the re-organisation of the arrangements for the publication of the Scottish Journal of Geology, Society Laws 9 and 11 were amended o 18 November 1992 to do away with the office of Convener of the Editorial Board and substitute two Scientific editors as members of Council.

[2] Following the death of Dr B C Lintern's death on 12 January 1993, Dr P Stone was co-opted in his place.

SCIENCE FESTIVAL

The Society supported the Edinburgh International Science Festival with a lecture by Dr R Gill on *Recycling Scotland*; as well as with guided walks through Holyrood Park.

CLOUGH MEMORIAL

A memorial plaque to Charles Clough was erected on the station building at Birkhill, on the Bo'ness and Kinneil railway, close to where he suffered his fatal accident.

RIGS

The working group on regionally important sites continued its work with Norman Butcher as convenor and Michael Smith as secretary, The group has the active support of Scottish Natural Heritage. A Number of sites are under consideration, with Torphin Quarry likely to be designated in the near future.

SUMMARY OF ACCOUNTS

For year ending 30 September 1993

New accounting and auditing procedures following the Charities Accounts (Scotland) Regulations 1992 coming into force, require some changes in the presentation of the figures. These are:

a. Income from publication sales sold are to be shown separately;
b. expenditure to be split between administrative costs and direct charitable activities;
c. permanent endowment funds and unrestricted funds to be separately listed.

Revenue accounts for the year ending 30 September 1992

	General	*Publ's*	*Clough*	*Mykura*	*Total* 1993	*Total* 1992
INCOME						
Income from investments	2556	1583	442	288	4879	5438
Bank interest	168	104	29	19	320	391
Subscriptions	5678	-	-	-	5678	6,069
Tax recoverable on Deeds of covenant	461	-	-	-	461	440
Sundry	-	-	-	-	-	16
Sale of publications	-	2834	-	-	2834	1410
Total income	**9211**	**4531**	**471**	**307**	**14530**	**13373**
EXPENDITURE						
Bank charges	471	4	-	-	475	436
Insurance	279	-	-	-	279	200
Reception	110	-	-	-	110	59
Administrative costs	528	-	-	-	528	168
Auditor's remuneration	528	-	-	-	528	500
Miscellaneous	19	16	303	-	338	65
Total	**1720**	**41**	**303**	**-**	**2064**	**1428**
Lectures	860	-	-	-	860	1043
Scottish Journal of Geology Vol. 29	-	1750	-	-	1750	3577
Billets	1908	-	-	-	1908	1855
Excursions (net)	867	-	-	-	867	881
Medal and Award	-	-	108	-	108	63
Celebrity lecture	-	-	-	-	-	259
Edinburgh Geologist	-	-	-	-	-	594
Additions to library	359	-	-	-	359	-
Borders Guide	359	-	-	-	359	-
Grants made	-	-	550	200	750	120
Total	**3994**	**1750**	**658**	**200**	**6602**	**7092**
Cost of publications	-	2043	-	-	2043	2524
Total expenditure	**5714**	**3834**	**961**	**200**	**10709**	**13044**
Surplus (deficit) for year	**3507**	**697**	**(490)**	**107**	**3821**	**329**

Balance sheet at 30 September 1993

	1993		1992	
	£	£	£	£
Fixed Assets				
Investment at market value		71178		61593
Current Assets				
Stock of publications	4847		4619	
Other stocks	394		448	
Debtors	806		521	
Taxation recoverable	253		1201	
Bank accounts	6273		2633	
Total	**12573**		**9422**	
Less:				
Creditors due within one year				
Sundry	653		1126	
Scottish Journal of Geology Vol. 29	1750		-	
Total	**2403**		**1126**	
Net current assets		10170		8296
Net assets		**81348**		**69889**
Representing:				
Permanent endowment funds		37222		33272
Unrestricted funds		44126		36617
Total		**81348**		**69889**

A copy of the full accounts may be obtained from the Honorary Treasurer.

The Society owns the following items not considered realisable:
Silver snuff box and silver cup presented to Alexander Rose; specimen cabinet and chair made by him; library of geological books; archive held in the University of Edinburgh library; and Hutton manuscript held by the National Library of Scotland.

Proceedings of the
EDINBURGH
GEOLOGICAL SOCIETY

160th Session
1993-94

No. 24 **November 1996**

INTRODUCTION

This, the twenty second issue of the *Proceedings*, covers the 160th Session 1993-94 of the *Society*.

MEMBERSHIP

Total membership at 30 September 1994 was 551, showing a welcome increase from the 1993 figure of 527 in the following categories:

Honorary Fellows	7 (8)	Senior Fellows	13 (11)
Corresponding	8 (8)	Family Fellows	36 (34)
Life Fellows	23 (24)	Glasgow	6 (7)
Ordinary Fellows	455 (429)	Junior	3 (6)

Twenty two fellows were elected and seventeen re-instated, but losses through deaths, resignations and removals totalled fifteen. We regret to record the deaths of Mrs V M Mitchell our oldest member, and of William Tulloch, life fellow.

We are pleased to report the election of the Society's vice-president John Hull to Fellowship of the Royal Society of Edinburgh. John was until recently Assistant Director of the Geological Survey.

COUNCIL

Following nominations at the AGM on the 18 November, the elected members of Council for the session were:

President	Mr S I Hogarth
Vice-presidents	Mrs C M Taylor and Mr J H Hull
Secretary	Dr R F Cheeney
Treasurer	Dr D Gould

Assistant Secretary	Dr C G Smith
Membership Secretary	Dr E Phillips
Excursion Secretary	Mr A D McAdam
Lecture Secretary	Mr J A Fairhurst
Librarian	Dr W B Heptonstall
Publications Sales Officer	Miss A E Hope
Edinburgh Geologist and Proceedings Editor	Dr A J Highton
Ordinary Members	Miss H McHaffie, Miss A C Paterson, Dr M J Gallagher, Mr N McMahon and Mr A G Sutherland
SWT and Lothian & Borders RIGS group representative	Mr M C Smith

Office-bearers not on Council

Trustees	Professor G Y Craig, FRSE, Dr C D Waterston, FRSE and Professor P McL D Duff, FRSE
Scientific editors	Dr D Stephenson and Dr P Stone
Auditor	Mrs M McLeod

TRUSTEES

Following introduction of new accounting procedures under Charities Accounts (Scotland) Regulations 1992, the trusteeship of the Society also required consideration and appropriate changes in the Laws are being debated. Heretofore the trustees have been three senior fellows who, by virtue of their office, are debarred from Council membership. Under the new regulations, the trustees are to be those actually in charge of the Society's affairs, i.e. the Council. Pending changes in the Laws, the trustees name above have been formally re-elected.

SOCIETY ARCHIVES

Formal agreement has been reached with Edinburgh University Library for housing and curating the Society's written archive, which remains open for inspection by a *bone fide* enquirer.

LECTURE MEETINGS

The following open meetings were held during the session:

13 October 1993
Reconstructing the past and predicting the future: from icehouse to greenhouse?
Professor G S Bolton
27 October
Landscape development in caves
Dr T Atkinson
10 November
The Trinil femur - the first big mistake in human palaeontology
Dr M Day
24 November
Volcanic carbonatites of northern Tanzania
Professor J B Dawson
This lecture was followed by the Annual General Meeting
19 January 1994
Engineers need geologists
Dr P R Thomas
2 February
Weathering and soiling of building stones
Dr J E Dixon
16 February
Fellow's Evening
2 March
The Geological Survey offshore regional mapping programme: its history and achievements.
Mr J H Hull (following the presentation of the Clough Medal)
16 March
The Tien Shan range of central Asia: a model for intra-continental mountain building
Professor B F Windley
20 April
From lherzolite to laterite: fluids and mineralization in the mafic/ultramafic realm
Professor E F Stumpfl (James Wright Memorial Lecture)

RECORD OF FIELD EXCURSIONS

7 May 1994	Oil- shales of West Lothian Mr D L Ross and Mr A D McAdam
14 - 21 May	Mull (long excursion) Mr S M Ross, Dr A R MacGregor and Dr K R Gill
28 May	Glen Esk Dr D Gould
8 June	Whinny Hill, Holyrood Park Mr D H Land
11 June	Cruachan Power station and Loch Lomondside Dr M A Paul and Dr C G Smith
15 June	Craigleith Quarry and Ravelston Mr N E Butcher and Mr R J Gillanders
22 June	Bilston Burn Mr M T Dean and Mr M A E Browne
25 June	Trearne and north Ayrshire Dr S K Monro
29 June	Lamancha Dr J D Floyd
9 July	Costorphine Hill Mr A D McAdam
27 August	Dundee and Sidlaw Hills Dr A R MacGregor
16 - 19 September	Arran Dr J G McDonald
1 October	Clachan of Campsie and Kilsyth Hills Dr N D L Clark

PUBLICATIONS

Volume 29 part 2 and volume 30 parts 1 and 2 of the *Scottish Journal of Geology* were published during the session. These were published by the Geological Society of London Publishing House for the Geological Societies of Edinburgh and Glasgow, at a net cost of some £1500 each per year between the two societies. There were 256 (266 last year) trade subscriptions from libraries world-wide. All academic periodicals show a decline in subscriptions, but the 4% drop for the *Scottish Journal of* Geology is less than the average fall. As well as subscriptions,

there were some 60 exchanges with libraries at home and abroad. In quality and quantity, the number of papers submitted for publication holds up well. At the end of the session there were enough in hand to complete volume 31 part 1 and most of part 2.

Number 27 of the *Edinburgh Geologist* was published in March 1994 and includes *Proceedings* No. 21 for the 157th session of 1990-91.

CLOUGH AND MYKURA FUNDS

The Clough Medal was awarded to the British Geological Survey in recognition of its research on the geology of the British continental shelf, published in the series of 1:250 000 maps. These show sea-bed sediments, Quaternary and pre-Quaternary geology. Also, a series of off-shore regional reports is in progress.

Grants from the two funds were made to assist research in Proterozoic rocks of Sutherland, in conodont faunas of Craen, and in Grampian migmatites. It ws decided to increase the capital of the Clough Fund to enable more realistic grants to be made.

RIGS

The Lothian and Borders RIGS Group, formed in 1992, was formally constituted as a committee of the Society in October 1994. Twelve possible sites hae been identified, of which two, namely Torphin Quarry and Dreghorn Link cutting, have been confirmed.

INTERNATIONAL SCIENCE FESTIVAL

Guided walks in Holyrood Park were again arranged and were reasonably ell attended.

SOCIETY SOCIAL EVENING

Over 80 members and guests enjoyed the social evening on 3 December. As usual MESS provided excellent food; and after dinner a sting quartet entertained with well performed and enjoyable music.

ACKNOWLEDGMENTS

The Society is pleased to thank members of Council and its committees, the trustees, and editors and referees of the *Scottish Journal of Geology* for the many hours of work they devote to the Society's affairs. Grateful thanks are also recorded for continued use of facilities in the Grant Institute and in Murchison House.

Summary of Accounts for the year ending 30 September 1994

REVENUE ACCOUNT

	General	*Publ's*	*Clough*	*Mykura*	*Total* 1993	*Total* 1992
INCOME						
Income from investments	2181	1285	323	231	4020	4879
Bank interest	197	116	29	21	363	320
Subscriptions	6054	-	-	-	6054	5858
Tax recoverable on Deeds of covenant	486	-	-	-	486	461
Sundry	63	-	-	-	63	178
Sale of publications	-	767	-	-	767	2834
Total income	**8981**	**2168**	**352**	**252**	**11753**	**14530**
EXPENDITURE						
Administrative costs						
Bank charges	521	-	-	-	521	475
Insurance	250	-	-	-	250	279
Reception	-	-	-	-	-	110
Administrative costs	321	95	-	-	416	334
Auditor's remuneration	600	-	-	-	600	528
Miscellaneous	-	-	-	-	-	338
Total	**1692**	**95**	-	-	**1787**	**2064**
Direct charitable activities						
Lecture costs	1075	-	-	-	1075	860
Scottish Journal of Geology Vol. 30	-	1500	-	-	1500	1750
Billets	1978	-	-	-	1978	1908
Excursions (net)	1059	-	-	-	1059	867
Medal and Award	-	-	136	-	136	108
Celebrity lecture	789	-	-	-	789	-
Edinburgh Geologist	-	720	-	-	720	-
Additions to library	250	-	-	-	250	359
Grants made	-	-	485	350	835	750
Total	**5151**	**2220**	**218**	**350**	**8342**	**6602**
Cost of publications	-	512	-	-	512	2043
Total expenditure	**6843**	**2827**	**621**	**350**	**10641**	**10709**
Surplus (deficit) for year	**2138**	**(659)**	**(269)**	**(98)**	**1112**	**3821**

Balance sheet at 30 September 1994

	1994		1993	
	£	£	£	£
Fixed Assets				
Investment at market value		67416		71178
Current Assets				
Stock of publications	4430		4847	
Other stocks	333		394	
Debtors	281		806	
Taxation recoverable	356		253	
Bank accounts	10250		6273	
Total	**10250**		**6273**	
Less:				
Creditors due within one year				
Sundry	1311		653	
Scottish Journal of Geology Vol. 29 Vol.30	1500		1750	
Total	**2811**		**2403**	
Net current assets		12839		10170
Net assets		**80255**		**81348**
Representing:				
Permanent endowment funds		45187		37222
Unrestricted funds		35068		44126
Total		**80255**		**81348**

A copy of the full accounts may be obtained from the Honorary Treasurer.

The Society owns the following items not considered realisable:
Silver snuff box and silver cup presented to Alexander Rose; specimen cabinet and chair made by him; library of geological books; archive held in the University of Edinburgh library; and Hutton manuscript held by the National Library of Scotland.

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