The Edinburgh Geologist

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Issue No. 38 Spring 2002

Silver Anniversary Edition

Incorporating the Proceedings of the Edinburgh Geological Society
for the 167th Session 2000-2001

The Edinburgh Geologist

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Cover illustration

The cover shows a specimen of the silver mineral proustite.

This is one of the oldest specimens in the National Museums of Scotland mineral collection and although no data exists, the locality is thought to be Germany. The scratches on the crystal faces indicate the low hardness of this mineral.

(see article by Brian Jackson on page 4 of this issue)

Acknowledgements

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Editorial

by Alan Fyfe

Welcome to this, the quarter-centenary edition of ***The Edinburgh Geologist***. Yes, it is twenty five years ago that ***The Edinburgh Geologist*** first hit the press and, as current Editor, I decided that this was something to celebrate, which is why you have a bumper edition!

The Edinburgh Geologist owes its existance to Helena Butler, a graduate of Edinburgh University who, in the late 1970s, decided that the Society needed a publication that would be of interest to the non-prefessional Fellows. The first issue was published in March 1977 under her editorship and, in 1979, the editorial team expanded to include Andrew McMillan. Helena and Andrew continued in that rôle until 1985, a magnificent (and as yet unbeaten) run of eight years during which they published no less than seventeen issues.

They had made it look far too easy! The next few editorial teams found it much more difficult to bring out the magazine out on such a regular basis and ***The Edinburgh Geologist*** entered turbulent times. It is difficult to keep chasing copy and still to meet the deadlines expected by Council. It requires time and tenacity, together with a thick skin (*Diplodocus* would have made a really good Editor) and a complete inability to understand the word 'no'. Maybe I have been lucky, but I am pleased to say that the magazine is now back on to a regular twice-yearly schedule.

But this anniversary year sees a significant change. As well as the printed version, we are now publishing on the Web. It would be a task of mammoth proportions to publish all the back issues, but I have made a start. All the contents pages are on the Web, a job made much easier by the sterling work of David and Fiona McAdam, who did this for the old web site. There are also a few packets of articles, such as Bill Baird's *Strange Earth* and the *What's in a Name?* series, plus a few other goodies. My intention is to publish the current edition after it appears in print and then any articles from back issues as they are requested.

I was going to write that the magazine will always be available in the printed form first, but maybe I should not use the word 'always'. Who knows what the future will bring? In 1977, the magazine was a xeroxed, typed affair; with advancing technology, it became word-processed and eventually desk-top-published. This edition will be the first to be sent direct from disk to press. **And** it is appearing on the Web. All those changes amount to an enormous advance and I, for one, cannot foresee what the next quarter-century will bring. Web-publishing could mean that regular production of Spring and Autumn issues might eventually become a thing of the past.

It would be a shame in a way. Some readers tell me that they like to hear the thud when ***The Edinburgh Geologist*** arrives through the letterbox. It would be the same kind of advance that has brought us strawberries all year round... giving us all the less to look forward to!

As part of the silver anniversary, Brian Jackson has written a specially commissioned article on silver minerals. Brian describes the history of the use of silver and its occurrence worldwide and in Scotland. I was amazed to read that the Ancients were extracting silver from lead ore 7000 years ago. With my love of words, I was also delighted to see that the article explains the origin of the mineral name *uchucchacuaite* (and how to pronounce it).

I also have a competition for you. Those of you with a complete set of ***The Edinburgh Geologist*** will find this easier than those without, but there are plenty of other ways of answering many of the questions. There is a prize for the first all-correct answer opened after the copy date for the Autumn 2002 issue, in which the answers will be given and the winner announced. In the event of no all-correct entries, then.the most complete solution will receive the prize. This is the splendid new publication *Minerals of Scotland* by Alec Livingston.

Coincidentally, this year sees the twenty-fifth anniversary of the opening of Murchison House. We mark this by an article by Radvan Horny on Roderick Murchison's visit to Bohemia in 1862. This is a translation of an article by Antonin Fric in the Czech journal 'Ziva' published in 1863. Ziva is the Czech name of the pre-christian Slavonic goddess of living organisms.

Of course, the year 2002 holds a more significant anniversary than that of twenty-five years of ***The Edinburgh Geologist*** or Murchison House, and that is the bicentenary of the birth of Hugh Miller. To celebrate this, we have an article by Mike Taylor on this enigmatic man. Mike looks at what geology meant to the people of that time, scientists and churchmen alike... and Hugh Miller was both of these and more, as you will read.

Throughout the history of this publication, Bill Baird has been resposible for publishing seventeen articles in a series ***Strange Earth***. The last of these was published in 1996 but, as part of the silver celebration, he has agreed to write a special ***Strange Earth No. 18***, where he tells us of iridescent fossils thrown up by volcanoes in Wiltshire (if *New Scientist* is to be belived).

In the *What's in a Name?* article, David Jones looks at geological features and mineral workings around Loch Tay and shows how these have been responsible for many of

the Gaelic place names there. David has drawn my attention to an article in the last issue of ***The Edinburgh Geologist***, where environmental geology was defined as including 'the preservation of human health and safety' and suggests that Scotland's first environmental geologist practiced, if unwittingly, in the Loch Tay area in 1342. There are also a couple letters referring to the Red Rocks and Agassiz articles that appeared in Autumn 2001. Thanks to Ian Winterflood and Alyn Jones for these.

I have a further wine for my Geo-vineyards, thanks to Cliff Porteous. I wish that I could publish the label in colour, because it is very bright indeed... but colour is, I am afraid, limited to the front cover in this issue. You will, of course, be able to see it in its full splendour when the magazine is published on the Web. Another advantage of technological advance, I suppose.

Thanks to Averil Hope Smith for sending in a contribution for Poet's Corner. Though this is actually a song, it is in French, which makes a first! It dates back to the 1912 meeting of the British Association in Dundee and was sent to her by a friend in the Inverness Field Club.

Angela's Rocksword Puzzle No 7 brings the edition to a close, though, as this is a Spring issue, the Proceedings for last year are appended. I should like to thank David Land for producing copy for the Proceedings in the years during which I have been Editor. It has made my job so much easier!

The copy date for the Autumn 2002 issue is 31st August. Several articles are promised but I am always grateful to accept more... as you all know so well.

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The copy date for the next issue of *The Edinburgh Geologist* is Saturday 31st August 2002.

An element of surprise: silver

by Brian Jackson

Silver is widely distributed in nature, occurring in the crust of the earth at concentrations of about 80 parts per billion...

In the beginning...

Silver has been known by humans since prehistoric times, and its discovery is estimated to have happened shortly after that of copper and gold. One of the earliest reference to the element appears in the book of Genesis (13, 2). The Egyptians considered gold to be a perfect metal, and gave it the symbol of a circle. Since silver was the closest to gold in perfection, it was depicted as a semi-circle. Later this semi-circle led to a growing moon symbol, presumably due to the likeness between the shining metal and the moon glow. The Romans called silver *argentum*, and we keep this alive by retaining Ag as the chemical symbol for this element.

Silver, like gold, was considered by the Ancients as an almost sacred metal and consequently, it had extremely restricted use. Because of its malleability and ductility it was easily worked and this, coupled with the lustre, made it ideal for ornamental purposes. It was also used for paying debts, for decoration in religious places, as utensils in the wealthiest houses and, of course, for personal adornment. Silver ornaments and decorations have been found in royal tombs throughout the world dating back as far as 4000 BCE.

Some mineral slags from old mines in the near-East and from some islands of the Aegean Sea reveal that, by 5000 BCE, a method was already known to extract silver from lead ore. The silver mines worked by the Carthaginians in Spain were well known and Roman envy of this wealth helped to bring about the Punic Wars.

Silver connections

With such a long history, few people are unaware of silver. Most people's knowledge stretches to knowing that it is a precious metal and it is mined. But where is it found, and how does it occur? Names such as Silver City in New Mexico (where Billy the Kid spent his early years and where Apollo 17 astronaut and geologist Harrison 'Jack' Schmitt grew up), Silverton, NSW, Australia (where some Castlemain XXXX beer advertisments were made and where Mad Max strutted his stuff) and our own (Scottish) Silver Glen near Alva, openly testify to the occurrence of nearby silver. Other localities are less obvious but are of no lesser importance and there are few countries throughout the world where silver is not found. We are familiar with the appearance of silver in jewellery but how does it look in its unprocessed state?

Silver minerals

There are 248 mineral species that contain silver as an essential component. Very very few names give an indication that the mineral contains silver. Minerals such as argentite (Ag_2S) and the more obscure argentocuproaurite ($(Cu,Ag)_3Au$) obviously indicate a silver content but what of eskimoite ($Ag_7Pb_{10}Bi_{15}S_{36}$) and vikingite ($Pb_5Ag_2Bi_6S_{15}$) and the almost unpronounceable uchucchacuaite (oo-chew-cha-co-a-ite for those willing to try) ($AgMnPb_3Sb_5S_{12}$). These last three belong to the sulphosalt category.

Eskimoite and **vikingite** are named in honour of the peoples associated with Greenland as the minerals were discovered at Ivigtut, Greenland.

Uchucchacuaite is named after its discovery locality at the Uchucchacua mine, Oyon, Cajatambo, Peru.

Definition

'sulphosalts' is the longstanding problem in mineralogy. Although the term 'sulphosalts' has long been in use, no generally accepted definition exists up to now. In chemistry, sulphosalts (thiosalts) are known as derivatives of sulphoacids (thioacids) [$H_3(AsS_3)$, $H_3(SbS_3)$, $H_3(BiS_3)$ etc]. In a broad sense, sulphosalts are regarded in mineralogy as compounds of metals and semi-metals with sulphur, which can be partially replaced by Se, rarely by Cl and O. The general formula commonly accepted for these minerals is $\mathbf{A_mB_nX_p}$, where:

A are metallic elements, usually Pb, Ag and Cu and less frequently Zn, Hg, Tl etc.,

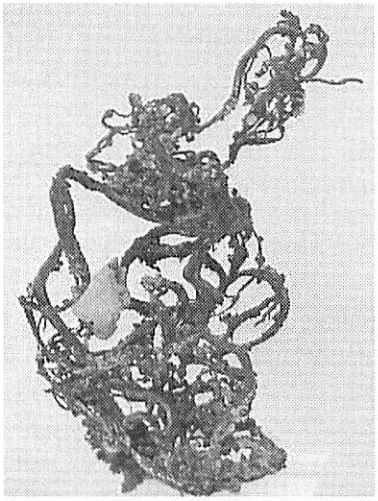
B are semi-metallic (formally trivalent) elements As, Sb and Bi (partly Te^{4+}) only,

X is S, partly Se, more rarely Cl.

Silver occurs as a wide range of minerals and also in its elemental form as native silver. Silver-bearing minerals are widely distributed but only a small number can be considered common.

Silver halides are found in the near surface oxidised portions of ore-bearing lodes, especially in arid climates. Small amounts of silver form in the oxidation zone as the more complex compounds erode and weather (sulphur depletion). At deeper levels silver occurs as sulphides, arsenides and antimonides (compounds of silver with sulphur, arsenic and antimony respectively). In these deposits, formation is the result of deposition from primary hydrothermal solutions. Argentite (Ag_2S), silver sulphide, occurs in low temperature hydrothermal veins in association with other silver minerals, or sometimes in the

cementation zone of lead and zinc deposits. Most silver is recovered from argentiferous galena and tetrahedrite or produced as a by-product in porphyry copper deposits, where it is present as a minor constituent in chalcopyrite. The contrast in silver mineralogy among deposits reflects differences in the availability of sulphur, semi-metals and base-metals.



Native silver wire from Kongsberg in Norway

Native silver is rare and often consists of wires that are curved and intertwined together, making an inspiring mineralogical curiosity. Such specimens are highly prized by collectors.

Silver was mined at Kongsberg, in south-eastern Norway, from the early 17th century until the mid-20th Century. The mines are one of the most famous silver localities in the world and produced some of the best silver specimen ever seen. The finest preserved specimens are today located in the Kongsberg Mining Museum and in the Geological Museum in Copenhagen. Natural wire silver has become so desirable that some dishonest people have resurrected an old recipe to manufacture wire silver by sublimation and are passing on the synthesised wire silver as natural.

Other silver minerals are also highly desirable, notably the so-called 'ruby silvers' proustite (Ag_3AsS_3) (see cover) and pyrargyrite (Ag_3SbS_3). These are isostructural, proustite being the rarer of the two. Proustite and pyrargyrite occur as a late-stage mineral in hydrothermal veins of low temperature origin with other silver sulphosalts. These two minerals have a striking scarlet red colour and adamantine lustre. Because of their magnificent colour and brilliance, some crystals have been cut into gemstones but, as they have low hardness (2-2.5), they are far too soft to wear. Proustite is the more transparent of the two minerals and yields the best gems. Fortunately most collectors value the uncut crystals more than the gems and few specimens are faceted, making these gems, proustite in particular, exceedingly rare and amongst the most sought after of the 'collectors' gems. This is probably just as well as the material darkens on exposure to light (a photochromic effect due to the silver present).

Proustite is named after Joseph Louis Proust (1755-1826), French chemist.

The name **Pyrargyrite** comes from the Greek *pyr*, fire, plus *argyros*, silver, alluding to its red colour and silver content.

The finest proustites known are in the collection of the Natural History Museum, London. The locality that produced the finest specimens is Chanarcillo, Chile, with superb crystals up to 7.5 cm long and 2.5cm thick. The best pyrargyrite specimens come from the Harz Mountains of Germany.

Proustite and pyrargyrite were first described in 1832 and 1831 respectively. The most recently described silver mineral is sicherite ($TlAg_2(As,Sb)_3S_6$) (2001) from the famous Lengenbach quarry, Binntal, Switzerland. It is named in honour of Valentin Sicher, active member of Interessengemeinschaft Lengenbach, IGL, an organisation with the aim of mining minerals at Lengenbach for research and collectors. Lengenbach is noted for its extensive range of rare sulphosalt minerals.

Silver in Scotland

The Leadhills orefield produced the greatest amount of silver. Between 1845 and 1919 twenty three tonnes were recovered from argentiferous galena, the richest lead ore producing 312 g/tonne. Significant amounts of native silver were found at Alva, near Stirling and Hilderston, near Bathgate.

Alva

Stephen Moreton presents the history and mineralogy of the silver deposit at Alva in an excellent article in the *Mineralogical Record*. In addition to describing the geology and mineralogy, he paints a lurid tale of Jacobite rebellion, fortunes made and lost, buried treasure, betrayal, deals with the government and a diversity of charming and not-so-charming characters.

The deposit, epigenetic hydrothermal veins in andesitic lavas, was worked intermittently from 1715 until 1768 producing an estimated five to six tons of silver. Latterly the deposit was worked, albeit for a very short period, for cobalt. Virtually the only silver mineral present is native silver, though EPMA detected minute grains of an unnamed silver-bismuth-selenide. Argentite has been reported but no specimens exist to confirm this. The native silver occurs as beautiful crystal dendrites up to 3 cm in length.

Hilderston

The most comprehensive account of mining is given by Meikle in the *Journal of the Russell Society*. The deposit was discovered in 1606 and production ceased in 1616 although in the 1750s, nickeline (NiAs), previously discarded by the silver miners, was recovered from the surface dumps and sold. The deposit is found alongside a quartz dolerite dyke intruded into Lower Limestone Group Carboniferous sedimentary and volcanic strata. Two distinct metallogenic assemblages have been identified,

only one of which contains silver. Few specimens from the deposit exist today. From the literature (Aitkinson, 1619) it appears that the native silver occurred as wire silver:

> the manner how it grew was like unto the haire of a man's head and the grasse in the fielde.

Meikle's work revealed the presence of two other silver minerals: acanthite (Ag_2S), and amalgam (Ag,Hg). The deposit was exceptionally rich and equally as short lived.

Uses

The naturally occurring silver halide minerals, chlorargyrite (AgCl), bromargyrite (AgBr) and iodargyrite (AgI) (no problem about working out how these minerals got their names) exhibit light sensitive properties. The reaction of silver halides to light spawned the greatest use of silver today, such that 40% of the silver mined is used in the photographic industry. A common use in the past for silver was to make coins, but today, only six percent of the world's silver is used for coinage. Another use for silver is the silvering of mirrors. Silver is used to coat smooth glass surfaces by vaporisation of the metal or by precipitation from a solution, though today, aluminium has largely replaced silver in this process. Silver is also used in the manufacture of switches, printed circuits, long-lasting batteries and bearing alloys for aeroplanes, diesel engines and some motor cars. When alloyed with copper, silver is used for welding. In its colloidal form, silver serves as a catalyst in the manufacturing of certain alcohols. When silver is alloyed with cesium, it is used in photocells and, in the form of silver iodide, it is used to seed clouds for weather modification purposes. So at least some clouds do have a silver lining.

Further reading

Aitkinson, Stephen, 1619. The discoverie and historie of the gold mynes in Scotland written by Stephen Aitkinson in the year MDCXIX pp.47-50, James Ballantyne & Co., Edinburgh 1825.

Meikle, 1994. Native silver from Hilderston mine, West Lothian, Scotland, *Journal of the Russell Society* , vol. 5, part 2, pp. 83-90.

Moreton, Stephen, 1996. The Alva silver mine, *Mineralogical Record*, vol. 27, pp. 405-414.

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Silver anniversary prize competition

set by the Editor

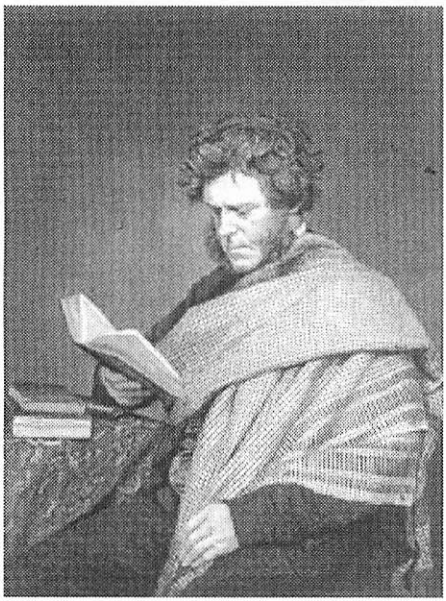
To celebrate the silver anniversary of this publication, I have devised a little competition. The answers can all be found in past numbers of *The Edinburgh Geologist*. Because of editorial difficulties in the past, not all years are represented by two issues or even a single issue, in which case you will have to search around! Please send in answers to me by 31st August 2002. There will be a prize too - the forthcoming publication *Minerals of Scotland* by Alec Livingston.

1977. On what day and month this year was Murchison House officially opened?
1978. What are the names of the two principal volcanic vents on Arthur's Seat?
1979. In what year were the South Orkney Islands discovered by captains Powell and Palmer?
1980. What Scottish stone was used for the floor of Cologne Cathedral?
1981. In what month and year did the late Ian Sime first visit Smoo Cave?
1982. In what year was the Brent Oil Field discovered?
1983. Who was the chemist who first isolated the element Strontium?
1984. Who was President of the Edinburgh Geological Society in 1864-1865?
1985. What geological examination was first held in this year?
1986. What scientific device was used in the Royal Observatory, Edinburgh from 1919 to 1962?
1987. Where was the Edinburgh Geological Society's 11th long excursion held?
1988. Where was Robert Dunlop working on behalf of the Pumpherston Oil Company in 1899?
1989. Who was the President of the Edinburgh Geological Society in 1975-1977?
1990. What are the two principal minerals in harzburgite?
1991. What is the connection between Saltire Court in Castle Terrace and the Edinburgh Geological Society?
1992. What year saw the building of the cottage in which Hugh Miller was born?
1993. From where was the gold taken that was used to fashion the sixteenth century Scottish Regalia?
1994. In what year was Charles Thomas Clough born?
1995. What effect was the Storegga Slide believed to have on Scotland?
1996. In what year did Charles D Walcott discover the Burgess Shale fauna?
1997. What were the dates of the first ever Scottish Geology Week?
1998. What meeting brought Gideon Mantell to Edinburgh in 1850?
1999. By what name was James Lewis Macie more famously known?
2000. What English town has as its symbol a ichthyosaur?
2001. After who or what is the mineral Susanite named?

Hugh Miller and his fossils

- a bicentenary appreciation -

by Michael A Taylor



Portrait of Miller in his 'maud' or wrap. Print by Bell after a photograph by Tunny. Photo Suzie Stevenson, courtesy and copyright the Trustees of the National Museums of Scotland.

Hugh Miller is probably considered by readers of this magazine as a geologist. Yet geology formed only a small part of the life's work of this Cromarty mason, banker, writer and editor of the major Edinburgh newspaper *The Witness*, which first appeared in 1840. He helped to create the support for the establishment of the Free Church in the Disruption of 1843, in protest at lairdly and government interference with the Church of Scotland. With its anti-lairdly politics further influenced by Miller's experiences as a humble mason, *The Witness* was one of the few mainstream newspapers to denounce the Highland Clearances. Editing the paper, and writing much of the content, Miller alleviated his massive workload with regular afternoons' fossil-hunting, and a month's annual leave visiting family in Cromarty by an indirect route to take in more Scottish fossil sites for a book he never finished. Always desperate for copy, he wrote up many of his trips, as when he visited his old friend the Reverend Swanson who tended his Small Isles parish from the leaky 'Free Church Yacht *Betsey*'.

So was Miller's geology simply a hobby of no particular relevance to the day job? I don't think so. This active, Calvinist, Free Churchman and crusading editor made geology mesh with his wider world view in sometimes surprising ways. Let us look, not so much at the practicalities of Miller the field geologist and collector in shepherd's tweeds and wrap, ripping up the ground and chapping open nodules with his mason's skill (though that is impressive and interesting in its own right) but rather what his fossils meant to him and to others.

As a young apprentice Miller was first entranced by the Jurassic fossils of Eathie on the Black Isle. A decade or so later, in 1830, he reasoned out a simple model of local geology which predicted more Jurassic nearer Cromarty, on the other side of the

South Sutor headland's 'granitic gneiss'. Remember this is when he had no geological contacts and just a few odd books and articles, and doing it just for his own satisfaction, a 'Robinson Crusoe of geology' as he put it. He soon spotted a likely-looking nodule:

> I laid open a nodule with a blow of the hammer, and my heart leaped up when I saw that it enclosed an organism. A dark, ill-defined, bituminous mass occupied the centre; but I could detect what seemed to be spines and small ichthyic bones ... I eagerly wrought on, and disinterred, in the course of a single tide, specimens enough to cover a museum table; and it was with intense delight that, as the ripple of the advancing tide was rising ... I carried them to the higher slopes of the beach, and, seated on a boulder, began carefully to examine them ... I had got amid the remains of an entirely different and incalculably more ancient creation.

Thus he discovered new fossil fishes of the Old Red Sandstone, quite literally an older 'creation': geologists such as Georges Cuvier then believed in successive mass extinctions and new divine creations, which matched the then-known fossil record.

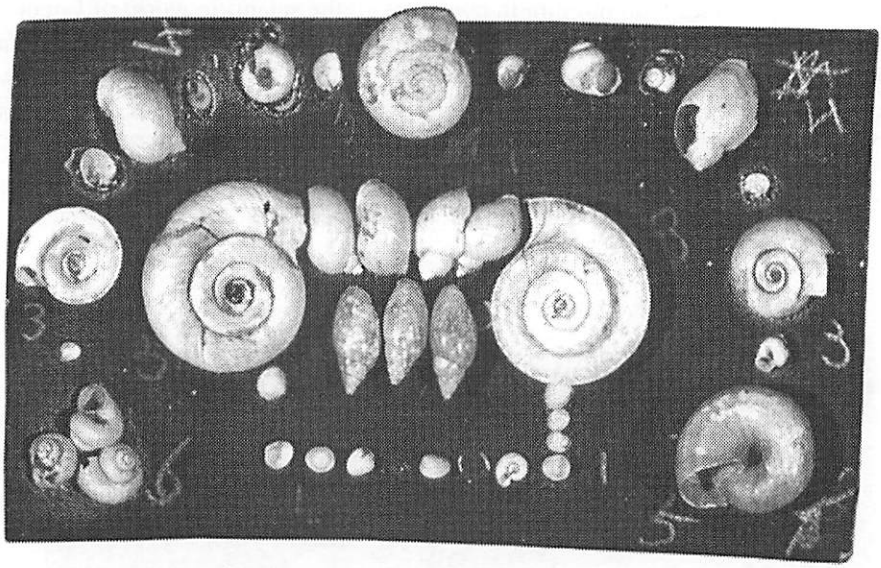
From the middle 1830s onwards, Miller got to meet other geologists, crucially John Malcolmson of Forres who put him in contact with the scientific world of London and the Continent. Edinburgh was of course much more convenient. Miller was a fairly active member in the Royal Physical Society of Edinburgh, an old society revived in the 1840s and '50s seemingly as a venue for the city's natural scientists

Miller's classic Old Red Sandstone site on the Cromarty foreshore, looking west towards the town. Photo courtesy and copyright the Trustees of the National Museums of Scotland.

asan alternative to the moribund Wernerian controlled by Robert Jameson, and without the social status required by the RSE. (I am not sure whether Miller took much part in the Edinburgh Geological Society, or if not, why not: something for future research!)

Lyall Anderson and I are beginning to consider the Miller collection as a whole. As Lyall points out, it has much fragmentary but scientifically valuable material. There is little sign of collecting for show – few, or no, 'décor fossils', and hardly anything bought in except perhaps items from local coal miners and the like. Nor did Miller gain kudos by giving away large numbers of specimens to museums. It is very much the collection of a serious collector with his own special interests. He even built a little private 'museum' in the back garden of his Portobello home, and when he started fretting about burglars, his neighbour Lord Kinnaird gave him a man-trap, with 'the engaging property of holding the robber without hurting him' as his biographer records - no doubt one of the 'humane' toothless variety, but still capable of breaking a leg.

Miller was always especially interested in Old Red Sandstone fossils. But he was also keen on what we call Quaternary deposits, seeking out topical evidence such as



Postglacial fossils of freshwater gastropods from the former Borough Loch on what is now the Meadows, Edinburgh, arranged in tasteful pattern on card, similar to an Ionic capital. Photo Suzie Stevenson, courtesy and copyright of the Trustees of the National Museums of Scotland.

cold–water molluscs from raised beaches. The then new idea of a massive icecap was challenging the older idea of Scotland being drowned under an iceberg-laden sea, but deciding between them was by no means easy from the then-current evidence – especially if, like Miller, one espoused the older view but also accepted the local development of mountain glaciers on land. Hence his portrayal of Ice Age Scotland:

> A foundering land under a severe sky, beaten by tempests and lashed by tides, with glaciers half choking up its cheerless valleys, and with countless icebergs brushing its coasts and grating over its shallows ...

Miller's contribution to Scottish geology lies partly in the fossils and sites he discovered. These included very substantial contributions of Old Red Sandstone fish, and his writings about them, which helped sort out their diversity and distribution and which the Swiss palaeontologist Louis Agassiz described in his major book *Poissons fossiles du Vieux Grès Rouge* [Fossil fishes of the Old Red Sandstone]: these were, after all, some of the oldest then known fossil vertebrates. *Pterichthyodes milleri* and *Coccosteus milleri*, and other fossils, were named after him. One must also add sites such as the Eigg reptile bed. Of course, Miller was not the only collector – but he was a big part of the wave of his time.

David Oldroyd interestingly suggests that, in a sense, Miller's biggest 'find' was the addressee of this letter:

> *Witness Newspaper Office, Edinburgh 15th January 1852*
>
> *My dear sir*
>
> *I trust to be quite at leisure on the evening of Saturday and expect to see you at six o'clock to take a quiet cup of tea with me, and discuss a few geological facts. A return omnibus passes my house at nine in the evening for Edinburgh.*
>
> *Yours truly,*
>
> *Hugh Miller*

That was to the young Archibald Geikie, whom Miller encouraged to give his first paper at the RPSE on the Jurassic of Pabay. Geikie rose to be Director-General of the Survey, President of the Royal Society and a big man in British government science.

Miller examined his finds with great care and attention to detail, and did a pretty good job of working out their anatomy. Yet Miller was no major publisher of

formalresearch papers, compared to some other Victorian amateurs. He had a heavy load in the day job. Perhaps, too, he preferred to spend his spare time, not writing formal descriptions, but hunting for fossils and writing for the general public, though his massive and meaty articles seem more like work than recreation. Certainly, he made his biggest impact on geology by improving the public understanding and support of the science.

Of course, one cannot say that Miller was the greatest, or the third greatest populariser... By its nature, popular science writing is difficult to assess. It is comparatively neglected by historians' emphasis on formal scientific literature. And how does one measure popularity, or compare, say, Richard Fortey to Stephen Jay Gould? Miller had his competitors, or perhaps one should say colleagues. Gideon Mantell of *Iguanodon* fame wrote books on fossils which were popular, in both senses. And even Lyell's *Principles of Geology*, not what we'd call a popular book, sold very well. I'd simply say Miller was right up there in the pantheon of the great Victorian popular science writers. And here is Geikie again:

> I do not think that the debt which geology owes to him for... deepening the popular estimation of the science... has been sufficiently acknowledged... Hugh Miller was looked upon by the general body of his countrymen as the leading geologist of the day. And this exaggerated but very natural estimate spread perhaps even more extensively in the United States. His books were to be found in the remotest log-huts of the Far West, and on both sides of the Atlantic ideas of the nature and scope of geology were largely drawn from them.

Geikie rightly points out here that non-scientists take the views of a writer with a high public profile as typical of all scientists: still an issue today. But, in any case, Miller is often reporting others' work as well as commenting from his own observation and analysis. So he probably gives a good feel of geology then, and if it seems strange to us it's not because he was 'wrong' but because this was the current consensus on the then available evidence.

One might also wonder how many copies of *The Old Red Sandstone* were bought and read on the back of his autobiographical, political, and religious writings. Still, who's complaining? He made a big impact, especially on his home ground at a time when many thought that geology was against the Bible. Geikie on Miller again:

> His genial ardour and irresistible eloquence swept away the last remnants of the barrier of orthodox prejudice against geology in this country...

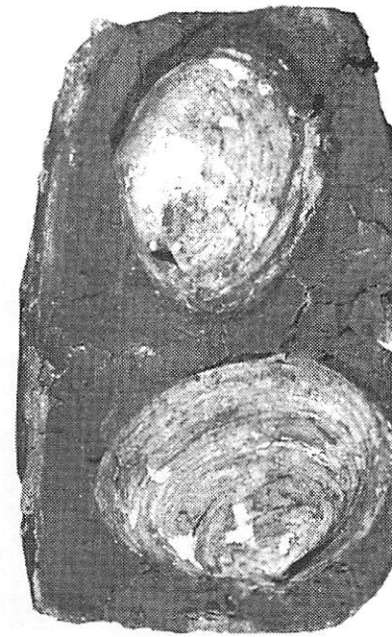
Miller was a fine writer, personal like a good TV presenter, but neither egoistic nor

intrusive. Without dumbing down, he gave clear accounts and very homely comparisons.

> A white zeolite... of crystals so extremely slender, that the balls, with their light fibrous contents, remind us of cotton apples divested of their seeds...

He was intensely visual, both at microscopic level, so typical of the Victorian love of detail, and on the great scale of spectacle - like *son et lumière* almost. He could at times be almost hallucinatory. Here he is on the Bass Rock's formation, incidentally showing the catastrophism normal for the time:

> The billows roll back, - the bared strata heave, and crack, and sever, - a dense smouldering vapour issues from the opening rents and fissures; and now the stony pavement is torn abruptly asunder, like some mildewed curtain seized rudely by the hand, - a broad sheet of flame mounts sudden as lightning through the opening, a thousand fathoms into the sky... and the volcano is born. Meanwhile, the whole region around, as far as the eye can reach, heaves wildly in the throes of Plutonic convulsion. Above many a rising shallow, the sea boils and roars...

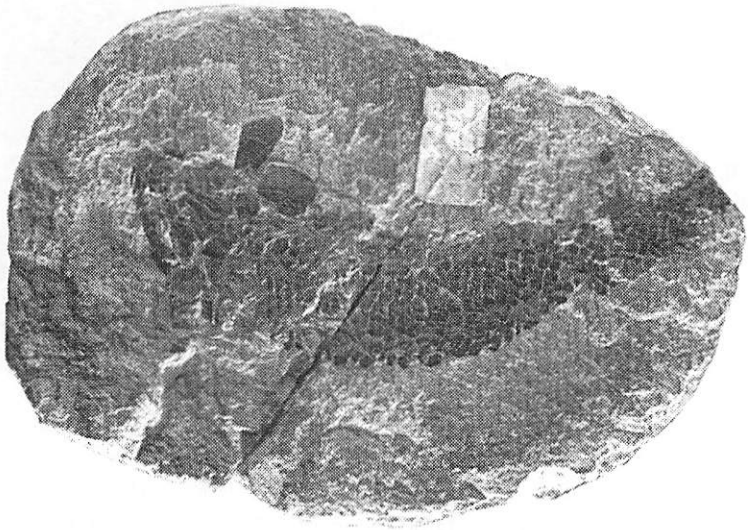


The estuarine clam Scrobicularia *from the raised beach at Portobello, in clay deposits that Miller interpreted as the estuary of the Figgate Burn at a time of raised sea level. Photo Suzie Stevenson, courtesy and copyright the Trustees of the National Museums of Scotland.*

Above all, he met the spirit of the time. As improving recreation, geology is very much part of the self-improvement theme of *My Schools and Schoolmasters*. It scored in being good mental and physical exercise without being frivolous. Anything that kept young lads out of the howffs and off the drink was a Good Thing. But geology had more going for it: it was basically the study of the Lord's works, a real contribution to 'natural theology' or what one could learn about God from His works as opposed to what had been 'revealed' in the Bible. Natural theology was of course a longstanding staple of Protestantism, and Archdeacon Paley had famously compared the cosmos to a watch lying in the road: even if you hadn't seen it made, the designful construction

proved the existence of a Maker. But Miller preferred to compare the Lord to a Scots country craftsman, as with fossil fishes:

> ... the art of the slater ... had been anticipated, - the scales had been slates fastened down by long nails driven in slantwise, which were however mere prolongations of the scale itself. ... it struck me as wonderful that the humble arts of the tiler and slater should have existed in perfection in the times of the Old Red Sandstone.



Osteolepis *from Miller's classic Old Red Sandstone site at Cromarty, showing the scales which, to him, were evidence of Divine design. Photo Suzie Stevenson, courtesy and copyright of the Trustees of the National Museums of Scotland.*

This mix of religion and science was then well out of date in formal scientific literature. But it would be wrong to dismiss Miller as an antiquated 'scriptural geologist'.

Firstly, he was often writing for the general public who not only wanted to know the latest scientific finds but how they fitted in with Life, the Universe, and Everything: and in that place and time that meant Calvinist Presbyterianism. He was, in fact, being a good journalist and writer – just like many professional scientists who today mix religion and philosophy with their science in popular writing.

Secondly, examined without the hindsight conferred by our knowledge of Darwin, Miller was pretty progressive. In books such as *Testimony of the Rocks*, he savagely attacked the precursors of today's creationists and young-earthers. Indeed, the Rev.

Philip Foster reprinted *Testimony* precisely because it still teaches modern Christians a few lessons.

To Miller, science and revealed religion (as in the Bible) were two faces of the same divine truth. He disposed of *Genesis*' portrayal of 6 days of creation c. 4004 BCE as Moses's vision of geological evolution – with clouds of vapour conveniently concealing the difficult bits, charmingly compared to steam intermittently obscuring the view from a train! Noah's Flood was simply a local Middle Eastern flood. But where he had real problems was evolution. The sort of evolution being hawked at the time was a progressionist, from-simple-to-complex type, basically Lamarckian (thus with nasty French revolutionary connotations), as tarted up for a middle-class audience by Miller's fellow Edinburgh geologist Robert Chambers (also born in 1802!) in *Vestiges of the Natural History of Creation* (1843). Miller denounced evolution:

> A form of error at once exceedingly plausible, and consummately dangerous, and which is telling so widely on society, that one can scarce travel by railway or in a steamboat, or encounter a group of intelligent mechanics, without finding decided trace of its ravages ...

Miller attacked *Vestiges* on scientific grounds, reasonably enough at the time, as in *Footprints of the Creator*. For instance, the Old Red fossil fish *Homostius* – which he called *Asterolepis*, working from fragmentary remains and inadvertently including bits of an unrelated fish – was big and complex, but also old. So it tended to refute the simple-then-to-complex-now model. And, of course, the then known fossil record was patchy and jerky – not like smooth progressive evolution. We interpret the organization of life in regular patterns of similarity as the obvious result of descent with modification from a common ancestor. But Miller, like many others such as Richard Owen, simply interpreted this as the Great Chain of Being, an old concept of the order and plenitude of divine creation, with simple at the bottom and complex towards the top, with Man near the apex and God at the peak. When Miller talks of such things as 'saurian fishes' (his 'saurians' are what we'd call amphibians and reptiles) or 'semi-reptile' fishes, he's not talking about fishes on the way to evolving into amphibians but simply fish placed on the scale near amphibians and so having some of their features such as big teeth.

But also he had a serious religious objection. It was a very Presbyterian viewpoint, based not on Biblical literalism but on individual responsibility before the Maker. Miller emphasised the division between human with soul, responsible for his actions, and irresponsible animal without. The problem was the supposed gradual transition from animal and human: to Miller, it didn't make sense to have the immortal soul

suddenly appearing between ape and human. Thus evolution posed Miller a dilemma. If animals had souls, yet they weren't morally responsible beings and religion was false – and all foundations of society were lost; but so too was the case if neither animals nor humans had souls. Of course, in 1859 Charles Darwin cut the scientific ground from under Miller's feet with the *Origin of Species*. Quite contrary to popular myth, many Presbyterians and Free Churchmen accepted Darwinism. But we shall never know what Miller would have said, because by then he was in Grange Cemetery.

Miller famously shot himself in the chest in his Portobello house in the wee small hours of Christmas Eve 1856. A myth has crept up that he shot himself because of the conflict between science and religion – but Miller saw no conflict, while Darwin's ideas were still confined to his study and close friends. Indeed, if Arnold Bennett's *Clayhanger* is to be believed, the nonconformists of the Potteries came to believe that the suicide was a Divine judgement for impugning the truth of the Bible. Poor Hugh couldn't win! Probably he simply woke up and thought, wrongly, he was going mad, thanks to hallucinatory nightmares arising from overwork and physical illness – his old lung disease, lack of sleep, and so on. But who can know? At any rate, most people certainly didn't blame him: they continued to buy his writings, systematically gathered together and republished under the supervision of his widow Lydia to whom we owe a great debt, for it is Miller's life we should remember, not his death.

Portrait of Hugh Miller from W.M. Mackenzie (1908) Selections from the writings of Hugh Miller. *Photo courtesy and copyright the Trustees of the National Museums of Scotland.*

Acknowledgements

This article stems from a presentation to the Edinburgh Geological Society on 16th January 2002. I have benefited from the insights of previous writers, especially David Oldroyd in Shortland (1996), and discussions with many colleagues, notably Lyall Anderson, Marian McKenzie Johnston, Simon Knell, Hugh Torrens, and John Burnett to whom I owe the Bennett reference.

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Recommended websites: www.hughmiller.org; www.nms.ac.uk

Mlke Taylor is Curator of Vertebrate Palaeontology in the Department of Geology and Zoology of the National Museums of Scotland. In 1993, following a D.Phil. on Jurassic plesiosaurs at Oxford University and jobs in museums in England, he began working on the Beginnings gallery in the Museum of Scotland, and then on the exhibition Testimony of the Rocks: Hugh Miller 1802-1856 *(9th March - 3rd June 2002) with fellow EGS members Lyall Anderson and Christine Thompson.*

Murchison in Bohemia

translated by Radvan Horny

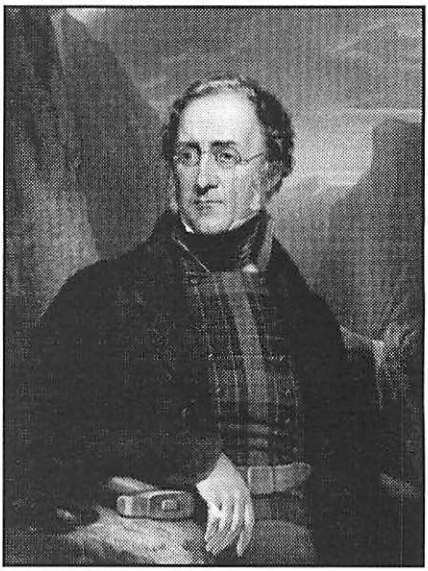
This article on Sir Roderick Murchison's tour of Bohemia in 1862 was written by Professor Antonin Fric and published in the Czech journal 'Ziva' in the following year. It has been translated into English by Corresponding Fellow Radvan Horny.

If a spectacular comet appears on the horizon, then the whole population is transfixed by the force of Nature and delights in seeing the phenomenon before it disappears.

If a man whose glory echoes all over the educated world should visit our country, then all who recognise the worth of that learned man, delight in revering one who has devoted his life to science.

The arrival of the British geologist Murchison in Bohemia last August should be taken as such an event, and I should like to let readers know some of the details of his stay in our country, as well as something of his character.

When I was in London during the World Exhibition last year, I had, together with Professor Krejci, the good fortune to be introduced to Sir Roderick Murchison. He received us very kindly, and in our short discussion, remarked that he was thinking of visiting Marianske Lazne in Bohemia. I offered him my services in the event of his planning to carry out any geological excursions, an offer that he was delighted to accept, and onAugust 30th I had the pleasure of welcoming him to Plzen.



Sir Roderick Impey Murchison

At the same time, the mining councillor Lipold arrived in Plzen. He had already explored a large part of Bohemia for the Imperial Geological Survey and, provided with proper maps, he was delegated to help Murchison during the geological excursions. Murchison wanted to see relationship of gneiss to the Silurian system, and a locality where the older gneiss (which he only quite recently discovered in north-west Scotland) was in contact with the younger gneiss. According to investigations to date, gneiss in Bohemia belongs only to the younger system, and the Silurian nowhere lies directly on this. Our guest therefore gave up any idea of excursions to the Archaic and resolved to visit some parts of the Silurian and Permian systems, which were both quite easy to get to by railway.

Stopping at the village of Ejpovice, we saw the Cilina Hill on the southern side, built of impressive beds of the Drabov quartzites. The valley below us led off to the north through a depression between the Komarov and Rokycany beds, where iron mines run into the ground in all directions. A short time before, railway cuttings had exposed the beds and made it easier to interpret the structure.

It really is a source of great pleasure being a geologist, one to whom every stone whispers words of everlasting Truth, one who sees irreversible Laws of Nature occurring over all the parts of the Earth. And how the attraction of a geological excursion increases when in the company of a man who, as an apostle of Science, was the first to pronounce these Laws and now follows their truth in various countries.

Murchison was the first to distinguish the Silurian system as the oldest division of beds characterised by fossils, and named it after that part of the British landscape, once inhabited by the ancient Silurs people, where this system is beautifully developed. A few years ago I travelled in this area with the well-known palaeontologist Salter, and I was therefore able to explain to Murchison the setting of our Silurian by means of correlation of our beds with those in Britain, which is, according to the present knowledge, in the table [overleaf].

After being cared for that evening by the Czech family of Mr Antonin Jelinek, an owner of a spinning mill in a town of Lochovice, the next day Murchison studied the landscape around the town Zdice, where shales and quartzites of the lower Silurian system border with basaltoids, supporting the Lower Silurian limestone basin. Murchison had already visited the region between Beroun and Prague in 1848 and therefore went by railway directly to Prague. He said candidly that he did not want to visit the enigmatic sites of the so-called Colonies, because he had not enough time spend there, and neither did he want to take a part in a dispute that concerned his old friend Barrande. Staying for two days in Prague, he visited Barrande again and examined the beautiful fossil collection of the Abbot Zeidler, being enormously surprised by the splendour and beauty of the specimens. He examined the collections in the Czech Museum very thoroughly, and discussed for a long time with Professor Krejci the relationship between the gneiss and the so-called Archaic shales in Bohemia which he, in analogy with northern Scotland, considers not to be Archaic but metamorphosed lowermost beds of the Silurian age.

Visiting the Patriotic Society, he conversed for quite a long time with professors Purkyne, Palacky, and Rieger, and had the benefit of a visit by Mr Vojta Naprstek, being informed that he was the only man in Prague who subscribed to the world journal "The Times" and was zealously interested in English and American literature.

Bohemian Silurian Beds	British Silurian beds
Lower system	
B. Pribram Shales	Cambrian System
C. Pribram Conglomerates and Jince Shales	Lingula Flags
D. d. 1. a. Krusna Hora Beds	Stiperstone?
b. Komarov Beds c. Rokycany Beds	Llandeilo
D. d. 2. Brdy Beds *d. 3.* Vinice Beds *d. 4* Zahorany Beds *d. 5* Kraluv Dvur and Kosov Beds	Caradoc
Missing bed in Bohemia	Llandovery
Upper system	
E. Liten and Chuchle Beds	Wenlock
F. Koneprusy Limestone	Lower Ludlow Aymestry Limestone
G. Branik Limestone	Upper Ludlow
H. Hlubocepy Shales	Passage Beds

Correlation between Silurian strata in Bohemia and the British Isles (1863)

On September 4th I again attended our distinguished guest on his way via Josefov to Ratiborice, from where we intended to make an excursion to a fossilized forest near the village of Radvanice. Murchison had letters of recommendation to Duke Lippe who, unfortunately, was away. We were received so unkindly by a deputy officer (an alien) that I blushed for shame and, being unable to get any hay for our weary horses, we had to return disappointed all the way to Josefov on the same day.

The next day we went to Horky by railway where we made an excursion to the Permian, observing here beautifully developed red sandstones and melaphyres. As well as the Silurian system, the Permian system was also christened by Murchison, named after the Permian province of Russia, where he found it most impressively developed and for the first time described it as a separate system.

He was troubled at the present time by the over-learned Germans who wanted to re-christen the old and honourable name of the Permian to the Dyas, and feared that his exhausting work in the Permian region would be forgotten.

On the same day we arrived at Semily and followed the beds in a railway cutting, as recorded in the excellent maps of the Imperial Survey.

On September 6th we went from Semily to Libstat, where Mr Maryska, a parish priest and a keen collector of natural objects, was our guide for the whole day. Here we saw an excellent fish locality in black shales near Kostalov and coarse-grained conglomerates with malachite sandstone in a railway cutting.

Quickly flying by railway through the Cretaceous system near Turnov and the Archaic slates at Zelezny Brod, we made the last excursion on the next day near Rychnov, where again Archaic slates, limestones, and porphyries occur.

Murchison left this place for Dresden to see the famous geologist Geinitz, and I went back to Prague. So I was rather surprised when after about three days, Murchison again appeared in Prague, going by the Plzen railway to Bavaria, where he wanted to continue his observations along the banks of the Danube. Seeing him to the Smichov railway station, as a farewell gesture, I drew in his notebook a profile of beds from the glorious Vysehrad over Dvorce and Branik, as it was possible to see from the stairs of the railway building.

A week after Murchison's departure, that well-known secret circular was sent out, in which the political officers were instructed to watch both of us travellers, to ensure

Map of the current Czech Republic showing some of the localities visited by Murchison in September 1862

that we were not engaged in political canvassing. As far as I myself was concerned, this matter did not surprise me, as our family had for many years had the pleasure of special attentiveness in this regard. The fact that even our celebrated guest, according to the style of the circular, was suspected, has been deplored by public opinion in domestic and foreign journals. A study of Murchison's biography best confirms how unsubstantiated were the apprehensions of the authorities.

Sir Roderick Impey Murchison was born on 19th February 1792 in Taradale, Ross-shire in Scotland. He received the first part of his education in the so-called Grammar School, and at 13 he entered the military school at Marlow. There he stayed till 1807, when he entered the 36th Infantry regiment. During this time, he stayed briefly at the University of Edinburgh, and in the Spring 1808 he sailed to Portugal with the Wellesley expedition and fought in the battles of Vimiera and Corunna. Later he served with his uncle A. Mackenzie's staff in Sicily, and took a part during the siege of Cadiz. Reaching a rank of captain in the 9th Dragoon regiment, he left the military service and married in 1815.

Since that time he enjoyed travelling over Europe and taking part in audacious fox-hunting. In around 1822, his loving wife tried to turn his mind to a less dangerous occupation than hunting foxes from fast horses, and herself began to collect Cretaceous fossils. Soon she succeeded in satisfying her husband of the importance of these relics of ancient times and inspired him to study them. Sir Humphrey Davy, with whom he met by chance when fishing, also influenced him so that he entirely devoted himself to science.

Between 1822-24 he attended lectures in the Royal Academy and educated himself in chemistry with Richard Phillips. Selecting geology as a subject of his research, he soon became a member of the Geological Society of the Royal Academy.

His first work in the field of geology was an outline of geological conditions in the counties of Sussex, Hampshire, and Surrey (Transactions of the Geological Society, 1826). During the following two years he investigated the Jurassic and Devonian systems in Scotland, and travelled with Charles Lyell over northern Italy and through the Auvergne in France.

Between 1828 and 1830 he studied with Professor Sedgwick the eastern part of the Alps. Coming back to England, he began to study systematically the ancient rocks of Wales and, after seven years of unstinting effort he produced an extensive work *The Silurian System* in 1838. This work deals mainly with the rocks that were deposited as the first containing remains of animal life. He divided them into upper and lower.

Anxious to find this system also on the European continent, he realised more journeys to the Rhineland, and in 1840 he travelled, together with the French scientist Verneuil, over north and central Russia. In the same year, the Czar Nicholas bade them explore his Empire from a geological point of view and they spent two years on this mission. Passing over the Urals eight times and thoroughly examining the southern territory of Russia, Murchison alone then visited the Tatra Mountains of Poland as well as Sweden, and in 1845 published, together with Verneuil and Count Keyserling, a large work in French about the geology of the European Russia and the Urals. For this work, Murchison was appointed a Knight of St. Anne and received a large cross of St. Stanislas from the Czar. Coming back to his homeland, he was made Knight by the Queen of England, and after publishing the book about Russia in English, he received the Copley Medal from the Royal Society in London.

In 1854 he published the work 'Siluria' in which he described the Silurian as a separate System, present in many parts of the old and new worlds, with an attached review of the world distribution of gold. His thorough work on the deposition of gold in the Urals contributed greatly to the discovery of gold in Australia. Murchison, analysing the rocks sent to him from Australia, recognised that gold should occur there, deposited in similar conditions to those in the Urals, and it was eventually discovered just as he said.

For several years, Murchison was the Director of the Institute of Practical Geology and President of the Geographical Society in London. He has an appearance of English aristocrat, and his upright posture and firm step, in spite of his substantial age of 71, show that he was a soldier when young. Tireless in his research from the early morning till late at night, he fervidly loves beautiful rocks, fossils, and Nature in general.

He is very thorough in observation, and has a great interest in historic sites, in folk customs and in Nature, diligently writing everything memorable in his diary.

His avowal that he will try to spend a future summer holiday in Bohemia demonstrates that he was satisfied with his stay in this country.

Dr Radvan Horny is a Corresponding Fellow of the Edinburgh Geological Society. Like Antonin Fric, he has dedicated his life to the Czech National Museum in Prague. This is the article that he promised in the piece on Corresponding Fellows (A Caseful of Correspondence) in the last issue of The Edinburgh Geologist.

Biographical note on Professor Antonin Fric

Professor Antonin Fric (1832-1913) is considered by many to be the greatest Czech museologist, pedagogue and educationalist of the nineteenth century. He devoted his life to the Czech Museum (Museum of the Czech Kingdom, now the National Museum). From 1855, he was curator of the zoological collections. In 1864, he founded the Geological-Palaeontological Department and from 1871 was Professor at Prague University. In 1880, he was made Director of the Zoological and Palaeontological departments of the Museum. He travelled widely, including to Great Britain, the Mediterranean, and the USA. His main works in zoology were monographs on European birds and Czech bats, fish, and crustaceans. In palaeontology, he wrote on the stratigraphy and palaeontology of the Czech Upper Cretaceous, Carboniferous and Permian fauna. He also published several important books about the popularisation of geology and palaeontology.

Professor Antonin Fric

The Hutton Memorial Garden

by Norman Butcher

This year sees the completion by Fountains plc of the construction of the Hutton Memorial Garden at St. John's Hill in Edinburgh. The architects for the project were Crichton Lang Willis & Galloway of Edinburgh and the garden has been constructed on what has been a small piece of waste ground since the late 1960s. The site coincides exactly with the house and garden of James Hutton (1726-1797), recognised throughout the world as the Founder of Modern Geology.

As the second son of William Hutton, merchant and City Treasurer, and Sarah Balfour, James Hutton abandoned farming in Berwickshire at the two small farms that he inherited from his father at the end of 1767. He returned to Edinburgh, building a house in the early 1770s at St. John's Hill, then a fancy new development within sight of Salisbury Crags where Hutton was to make his first profound geological observations. He lived with his three sisters and wrote the four books and other papers, including his *Theory of the Earth*, for which he is renowned. Hutton is still probably the least known of the four great figures of the Scottish Enlightenment in the second half of the eighteenth century, the others being Adam Smith, David Hume and Joseph Black.

James Hutton died at his house at St. John's Hill on 26th March 1797 and is buried in the Greyfriars Kirkyard in Edinburgh where his grave remained unmarked until 1947, the 150th Anniversary of his death when th then Lord Provost, Sir John Falconer, unveiled a plaque commemorating Hutton as the Founder of Modern Geology. To mark the bicentenary of his death, an International Conference was organised by the Royal Society of Edinburgh, which Hutton co-founded in 1783, in the Royal College of Physicians of Edinburgh. During the meeting, on the afternoon of Wednesday 6th August 1997, a bronze plaque, cast by Charles Laing & Sons Limited Foundry, was unveiled at the north side of the site of Hutton's house in the names of The Royal Society of Edinburgh and the Edinburgh Geological Society. Participating in the unveiling ceremony, attended by delegates and invited guests, were David Land, President of the Edinburgh Geological Society, Fraser Morrison CBE, Executive Chairman of Morrison Construction Group plc, Councillor Brian Weddell, Chairman of the Housing Committee of the City of Edinburgh Council, Professor Sir Stewart Sutherland, Principal and Vice-Chancellor of the University of Edinburgh and Professor Malcolm Jeeves CBE, President of the Royal Society of Edinburgh.

The bronze plaque was mounted on a single block of Clashach stone from the southern edge of the Moray Firth, a Triassic dune-bedded sandstone from a coastal quarry north of Elgin now being much used in major buildings, an outstanding example

being the National Museum of Scotland. On the cut face of the stone beneath the plaque, David Lindsay's Stone Carvers inscribed the famous final sentence of Hutton's 1788 paper: '...we find no vestige of a beginning, no prospect of an end'.

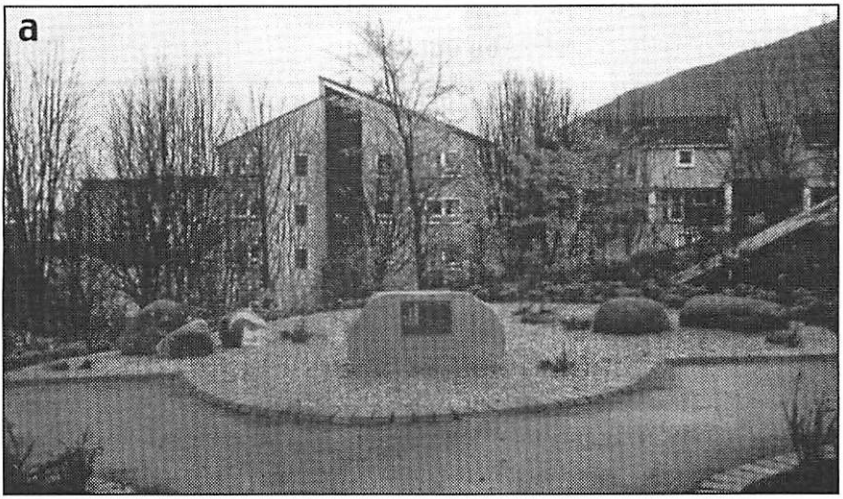
At the unveiling ceremony in 1997, the stone bearing the bronze plaque was surrounded by other large boulders intended to illustrate two of the main themes of Hutton's remarkable geological work. As Hutton's own collection of rocks had long-since disappeared, these were specially brought to St. John's Hill by Morrison Construction Group plc. Two boulders showing granitic veins came from the locality above the Duke of Atholl's hunting lodge in Glen Tilt which John Clerk of Eldin visited with James Hutton. These were provided by courtesy of Charlie Pirie, the Duke's Gamekeeper. These illustrate Hutton's work on the origin of granite from September 1785. The other three boulders were of conglomerate carried by ice and water came from Barbush on the edge of Dunblane and presented by Andrew Fleming & Sons. These illustrate Hutton's understanding of the cyclicity of geological processes.

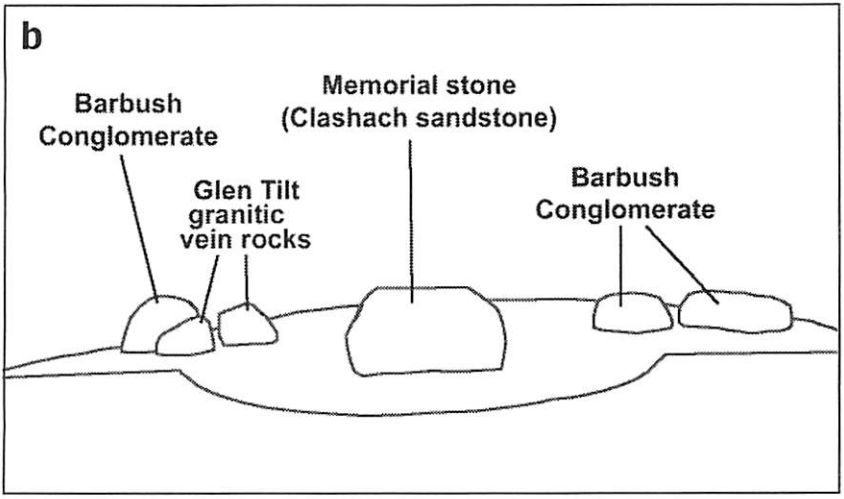
Since 1997, all these materials have been in store with the British Geological Survey in Edinburgh and they are now incorporated in the splendid new Hutton Memorial Garden. Excellent features in the design include a substantial flight of well-lit steps with railings leading up the steep bank from Viewcraig Gardens, with disabled access from the southern back of the garden by a ramped path leading from the University car park off the Pleasance.

How to get to the Memorial Garden

The Garden is located at St John's Hill and is best approached from Holyrood Road. A hundred metres east of the junction with the Pleasance, turn into Viewcraig Gardens and walk up past the entrance to the car park. About 50 m from Holyrood Road, a flight of steps leads up to the Garden. The University car park (for disabled access) can be reached through the arch north of the Sports Union, opposite the terminated end of Drummond Street. At the far end of the car park, on the left, a ramp leads down to the Garden.

Norman Butcher is well-known to Fellows of the Society. He has been associated with the Hutton Memorial Garden project since the idea was conceived in 1995, the bicentenary of the publication of Theory of the Earth, *when he suggested to the University that they acquire the site from Edinburgh City Council.*





The Hutton Memorial Garden

a. *photograph of the completed Hutton Memorial Garden*

b. *key indicating rock types of the memorial and surrounding boulders*

Strange Earth No 18

The mud springs of Wootton Bassett, Wiltshire

by Bill Baird

To mark the silver anniversary of the publication of The Edinburgh Geologist, *Bill has agreed to write a further* Strange Earth *to continue the series.*

The 'mud springs of Wootton Bassett' seems a fairly innocuous but interesting title, and forms part of the introduction to a paper in the Proceedings of the Geologist's Association. As reported in *New Scientist*, however, the headline ran 'iridescent fossils rise up from volcano'. There are not many active volcanoes in Wiltshire, so perhaps we should investigate the matter a little further. The site of the mud springs is a small wood called Templar's Firs, near Wootton Bassett. It seems that these features were drawn to the attention of the then Nature Conservancy Council by Willie Stanton in 1974. Rather than being the result of volcanic activity, however, it is understood that the mud springs were formed by water under pressure finding its way to the surface at the site. In its journey to the surface, it passed through a layer of clay which forms a colloid suspension in water. Of added interest at this site is the presence of well-preserved ammonites, brought to the surface by the upwelling mud. These Jurassic fossils are typical of the Ampthill Clay and indicate a Mid to Late Oxfordian age.

The initial description of these mud springs was of three domed blisters some 10 m long by 5 m wide by 1 m high. There was a skin of vegetation containing a core of liquid mud which oozed from any fissure in the skin to a nearby brook called Hancock's Water. It is from Hancock's Water that most of the fine ammonites and other fossils have been collected. The technical explanation for the occurrence of the mud springs is that they are related to the local geology, in that they occupy sites in valley bottoms cut into the Ampthill Clay along synclinal axes. They seem to be driven by groundwater in the Coral Rag aquifer which crops out and is recharged beneath Wootton Bassett. From measurements taken in order to understand the mechanism of the springs, it seems that there are irregularly-shaped chambers underneath the mud domes which do not seem to be deeper than 20 m. It is probable, however, that there are further lateral and vertical fissures allowing movement of water and mud into these chambers.

The mud springs at Wootton Bassett have caused considerable interest amongst geologists and others. During recent site investigation, the British Geological Survey has provided support and assistance with seismic, stratigraphical, geochemical and hydrogeological input (Bristow et al., 2000). Fossil collectors have made available their collections for study to enable the stratigraphy of the source rock to be accurately

defined. Further site searches in the general area have revealed similar springs near Greenham Common. Of course, no such site is free from the attentions of the well-meaning, if ill-advised, who wish to make it 'safe'. It was allegedly for this reason that approximately 100 tons of rubble were tipped into the most active spring in Wootton Bassett in 1990. The 100 tons of rubble disappeared without trace, except for the equivalent amount of mud which poured into Hancock's Water. This then had to be cleared from the brook by the long-suffering workmen of the local council.

It seems that, at present, activity is at a low level in the mud springs of Wootton Bassett. This is hardly surprising as they have been poked, jumped up and down on, dredged and sampled in various ways. However, what this site shows is how the mysteries of geology can occur on one's own door step. The mud springs of Wootton Bassett are a recognised part of the ancient town's social history, prompting a full-page write-up in the local guide *Welcome to Wootton Bassett*. They have also been the inspiration for some 50 papers in the literature and caused much argument and discussion amongst the scientific community.

Further reading:

Bristow, C.R. *et al.*, 2000 in 'The lithostratigraphy, biostratigraphy and hydrogeological significance of the mud springs at Templar's Firs, Wootton Bassett, Wiltshire', *Proceedings of the Geologists' Association*, volume 111, pp. 231-245.

Bill Baird is well-known to Fellows, having been the author of many articles for this magazine, in particular the Strange Earth *series, the first of which appeared in 1984. Bill was President of the Society towards the end of the last Millennium.*

Evolution and genetics

by Angus Harkness

In studies of evolution, the thinking of morphologists and geneticists sometimes seems unconnected, this despite a series of linking reviews (Maizels & Ashburber, 1994; Roberts *et al*, 1996; Lang, Gray & Burger, 1999). The word, evolution, appears increasingly in the Annual Review of Genetics. For amateur geologists, such papers may provide patterns which are sometimes understandable.

The need for living systems to use efficiently and thus conserve energy (Atkinson, 1977) prompted my suggestion that any mobile organism, especially when life emerged from the support of water, would tend to evolve further to reduce unnecessary weight including the amount of genetic controlling material, DNA, in cellular nuclei and mitochondria (Harkness, 2000). This has to be balanced against increase in the amount of DNA per cell associated with evolutionary progress (see below).

Plants, which were first to emerge from the water and colonise the land, have large amounts of DNA per cell in their nuclei and in their mitochondria. However expressed (as micrograms per cell or per nucleus, or as millions of base-pairs in the genome), the figures show a pattern consistent with this hypothesis. Plants have about 5-200 micrograms of DNA per million cells, most amphibia 5-15 micrograms of DNA per million cells, most other animals 1-2 micrograms of DNA per million cells, but mammals have about 5 micrograms of DNA per million cells (see Sober (1973) and references cited therein). These early data have now been refined by sequencing the chains of DNA but, so far, in only six nucleated species, two yeasts, a plant, a worm, a fruit fly and man (Bork & Copely, 2001). In addition, the fruit fly has removed from its nuclei inactive genes (pseudogenes) at about seventy times the rate in man.

However, the DNA in the energy producing subcellular mitochondria has been sequenced for about 20 years. The coding in the DNA is by sequences of molecules of purine and pyrimidine bases. Sequences for mitochondrial DNA for 86 animal species are available (Lang, Gray & Burger, 1999). These animal mitochondrial DNAs are small, about 16,000 base pairs. Fungi, 6 species, have about 20,000-100,000 base pairs and plants, only 2 species, have 200,000 to 300,000 base pairs. These figures suggest that about 1000 genes (control assemblies) have been lost *from* mitochondria during the establishment of the mitochondrial genome. The mechanisms include migration of mitochondrial genes to the nucleus and takeover of mitochondrial control by nuclear genes. The mitochondrial genes that are left in man largely specify big scaffolding proteins which are difficult to move into mitochondria. The limited data in plants suggests evolution has gone in the opposite way.

Evidence from plants shows that larger amounts of DNA are associated with biological success. Plants frequently use multiple sets of genes, polyploidy (Otto & Whitton, 2000). In ferns, about 2-4% of changes producing species involve polyploidy; in flowering plants, chromosome doubling may 'propel a population into a new adaptive sphere'. Isolated gene reduplication is used successfully in animals to produce new control proteins while maintaining the essential original protein.

From the evidence outlined above, it would seem unwise to regard DNA with no known function at present as junk left over from history.

The sequence of evolution largely derived from geology is important in arranging and then understanding events in biology. How can we test the above hypothesis? A test might be based on the increase in cell size associated with polyploidy in plants and some invertebrates. Does an increase in cell volume in an earlier strata precede the appearance of a new closely-related species further up the geological column?

References

Atkinson, D.E., 1997. *Cellular energy metabolism and its regulation*, Academic Press, London, 293p.

Bork, P. & Copely, R., 2001. Filling the gaps, *Nature*, volume 409, pp. 818-820.

Harkness, R.A., 2000. Evolutionary problems in Australia, *The Edinburgh Geologist*, volume 34, pp. 22-25.

Lang, B.F., Gray, M.W. & Burger, G., 1999. Mitochondrial genome evolution and the origin of eukaryotes, *Annual Review of Genetics*, volume 33, pp. 351-397.

Maizels, N. & Ashburner, P., 1994. Genomes and evolution, *Current Opinion in Genetics and Development*, volume 4, pp. 797-938.

Otto, S.P. & Whitton, J., 2000. Polyploid incidence and evolution, *Annual Review of Genetics*, volume 34, pp. 401-437.

Roberts, D.McL., Sharp, P., Alderson, G. & Collins, M.A., 1996. *Evolution of microbial life*, Cambridge University Press, 299p.

Sober, H.A., 1973. *Selected data for molecular biology, Handbook of biochemistry*, 2nd edition, CRC Press, Cleveland, Ohio, p H110 (see also 3rd edition).

Angus Harkness is a biochemist with an amateur interest in geology. He has been a Fellow of the Society since 1993 and was a member of Council. He has worked on biochemical genetics for the Medical Research Council, the University of Edinburgh and the National Health Service.

What's in a Name?

Gaelic names around Loch Tay

by David Jones

Loch Tay lies in the middle of a wide swath of Dalradian rocks that run across Scotland but the geology on the northern and southern sides of the loch is quite different.

To the north, Ben Lawers is well-known for the Alpine-type flora that grow on the Loch Tay Limestone and its associated calcareous schist. These make good farming soils too, and the *Bal-* (farm) and *Acha-* (field) names indicate that this was recognised long years ago when Gaelic names supplanted the earlier Pictish names. As an aside, a number of Pictish *Pit-* names can be found to the east of Kenmore.

The southern side of Loch Tay is very different. Like the north, it is composed mainly of schist, but the difference lies in the number of igneous rocks that have been intruded. These have led to the development of metalliferous ores in some areas.

In around 1840, the Marquess of Breadalbane is recorded as having 'caused the copper mine at *Tom na Dashan* to be opened'. However, if we look at maps of the area made prior to 1840, these show, not very far to the west, the *Allt a 'Mheinn*: the 'burn of the mine or ore'. Did the Marquess discover the source of ore as is claimed or was he perhaps simply re-opening a source previously worked?

There are, in fact, a large number of *meinn*-associated names across Scotland from Crinan and Loch Fyne to Lairg and Loch Fleet. The challenge is to relate them to the information given in the Geochemical Atlas for the areas.

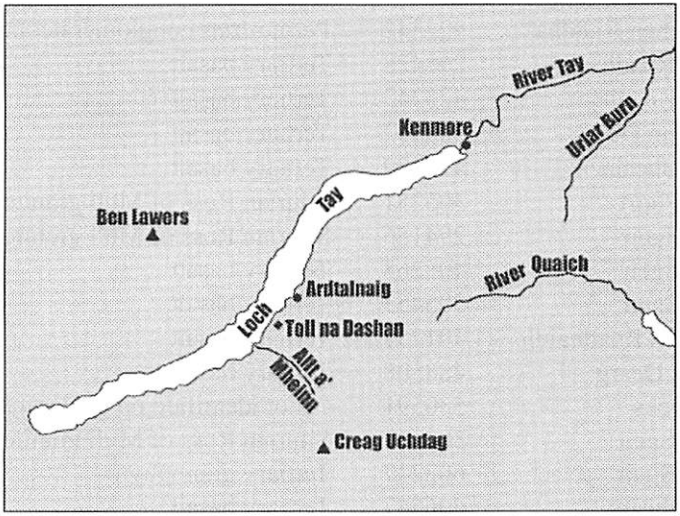
To return to *Tom na Dashan*, if the name were a corruption of *Tom na Dathan*, the translation would be 'stained hillock', which would figure because the adit is still open and has blue-green copper compounds showing around its mouth. To the southwest of *Tom na Dashan* is a hill now shown on O.S. maps as *Creag Uchdag* but on earlier maps it is *Creag Uigeach*: 'the crag abounding with precious stones'. The geological map shows both copper an lead sources nearby. The eastern spur of this hill is separately named as *Toll na Poite*: 'the hole of the pot', and aerial photograph interpretation suggests that bell-pit working may have gone on there at some time.

To the east, the Urlar Burn flows down into the Tay past the farm of the same name. *Urlar* is normally translated as 'lowest part' and, incidentally, is the name given to the underlying or main theme in pibroch pipe music. But it can also be translated as 'a layer or vein as in a mine'. Two copper sources are shown on a geological survey map beside the Urlar Burn.

The name of *Ardtalnaig* has changed over a considerable number of years. It appears as *Ardintollanie* (1640), *Ardtollony* (1564) and *Ardentollenie* (1536). In the light of lead and zinc ore sources being shown within 300 metres on the geological map the cape (*ard*) of the little pits (*tollan*) looks like an indicator of early mining.

Incidentally, it is recorded that in 1342, *Ardtalnaig* had a *Toiseachdeor*, who was an important officer of the law in Celtic times. His rôle was probably that of a coroner and it may be asked whether he was needed in such a small place to investigate suspicious deaths from lead poisoning?

Over the hills to the south lies Glen Quaich. *Cuach* is the Gaelic for a hollow (the same word is used as a drinking vessel). But its meaning can also include mining pot holes, so it is no surprise that the Royal Commission Ancient and Historic Monuments' map of the area shows an old mine spoil tip beside the River Quaich. One of the burns that runs into the River Quaich is the *Allt Salach*, which translates as 'polluted burn'. The word *salach* also occurs in a number of other places in Scotland where early mining could have taken place. It is possibly an indicator of the washing of the ore in the burn nearest to the mine.



Area around Loch Tay showing locations referred to in text

In a previous existence, David Jones was an electronic engineer. In thirteen years of retirement, he has become more involved in geology and archaeology and he says that where they overlap, such as in ancient mining, his interest doubles. He is also a member of the Scottish Place Names Society.

Red Rocks - postscript

I received the following letter which I thought might interest readers:

Dear Alan

I have just read and enjoyed your article in the last issue of *The Edinburgh Geologist* about 'Red Rocks' and would like to add some of my own observations... On field courses to Skye and Mull I have used names to help students identify the location of acid and basic Tertiary outcrops. On Mull I use *Riadh Sgeir* (602247 - granophyre) and *Rubha Dubh* (570213 - basalt), both near Lochbuie as examples. On Skye, *Meall Dearg* (4923) distinguishes a patch of red *Meall Dearg* Granite from the surrounding basic rocks of the .Black Cuillin'.

My letter concerns Mull... you suggest that 'there is a paucity of red place names' on the island. Certainly they are not numerous, but I am aware of 23 on Mull and surrounding islands (including the ones that you have already identified):

1.	Aird Dearg	463390	Tertiary basalt
2.	An Geodha Dearg	260230	Lewisian amphibolite and iron bands
3.	Boghachan Ruadha	422342	Permo-trias conglomerate/ breccia
4.	Bogha Ruadh	298428	Tertiary basalt
5.	Cadha Ruadh	423243	Tertiary basalt
6.	Cruachan Dearg	568332	Tertiary basalt
7.	Dearg Bhealach	475199	Tertiary basalt
8.	Dearg Phort	305251	Silurian Ross of Mull granite
9.	Dearg Sgeir	294156	Silurian Ross of Mull granite
10.	Dearg Sgeir	405268	Tertiary basalt
11.	Dearg Sgeir	595453	Tertiary basalt
12.	Eilean an Ruadhaidh	491257	Tertiary basalt
13.	Lochan Dearg	488508	Tertiary basalt
14.	Red Rocks	530591	? (not identified on geological map)
15.	Ruadh Sgeir	308149	Silurian Ross of Mull granite
16.	Ruadh Sgeir	602247	Tertiary granophyre
17.	Sgeir Dhearg	406547	Tertiary basalt
18.	Sgeir Ruadh	276223	Silurian Ross of Mull granite
19.	Sgeir Ruadh	434411	Tertiary basalt
20.	Sgeir Ruadh	732362	Tertiary craignurite
21.	Sgiath Ruadh	565447	Tertiary basalt
22.	Sgriob-ruadh	493550	Tertiary basalt
23.	Sgurr Dearg	665340	Tertiary volcanic breccia

No. 2, from Iona, introduces rocks of an age not mentioned in your article - the Lewisian. The map published by the Iona Community shows the name *An Geodha Dearg* and also indicates that the rock is Lewiaian amphibolite with iron-rich bands [*geodha* translates as a creek or coveformed by surrounding rocks].

You suggest that the 'Ross of Mull is lacking in red place names despite being granitic'. In fact at least one 'red' name does exist, no. 8 on my list *Dearg Phort*, just north of *Fionnphort* (352251) [*Fionnphort* translates as white harbour and *Dearg Phort* as red harbour]. In addition, there is no. 18, Sgeir Dearg, which lies just off the coast of Iona, but which is also formed from the Ross of Mull granite. (This is another example I use with my students as it shows that the fault which runs through the Sound of Iona, possibly a continuation of the Moine Thrust, must lie very close to the east coast of Iona).

Mull also provides an example, no. 3, from the 'just about hopeless' New Red Sandstone. Off the coast of Gribun is the rocky outcrop of *Boghachan Ruadha* which, according to the new Staffa geological map, is formed of Permo-triassic conglomerates and basal breccia.

What is perhaps most surprising about Mull, however, is that over half (13) of the 'red' place names are actually found where the bedrock is basic basalt and would be expected to be black. Presumably this is due to weathering either in the Tertiary (producing bole), or more recently, oxidising the iron.

Yours sincerely

Ian Winterflood
Geology Department, Arnold School, Blackpool

Little did I know when I wrote the original article that there was so much detail on the links between place names and geology. And this is only on Mull...

If anyone else has further information on place names either in the Tertiary igneous province or elsewhere from Scotland, I'd be glad to publish it in this series. The Scottish Place Names Society has a database of 8,000 Scottish place names, including 13,500 historical forms. Unfortunately funding for the development of this has dried up. Nevertheless, the data provided by Ian and others might be of interest to them and I shall pass it on.

In the meantime, please keep articles relating to What's in a Name? *flooding in... they generate more correspondence than any other series!*

Louis Agassiz - postscript

The original article relating to Agassiz Rock, which appeared in the Autumn 2001 issue of The Edinburgh Geologist, *was not part of the* What's in a Name? *series but this letter does refer to a place named after him, so it seemed right to publish it here:*

Dear Alan

The most recent edition of *The Edinburgh Geologist* arrived yesterday... I was particularly interested in the piece about Agassiz as his name is perpetuated in Canada in 'Lake Agassiz'. Holmes refers to it in his textbook (1st edition, p. 242):

> To the north-west [of the Great Lakes] another series of lakes originated in much the same way, beginning their history as marginal lakes which coalesced into a gigatic sheet of water referred to as Lake Agassiz. The flat-lying sediments of the floor of this vanished lake form the rich wheatlands of North Dakota and Manitoba. At first, Lake Agassiz drained into the Mississippi, but lower outlets were uncovered to the north later on, and the vast lake was reduced to remnants, including Lake Winnipeg, Lake Manitoba and The Lake of the Woods.

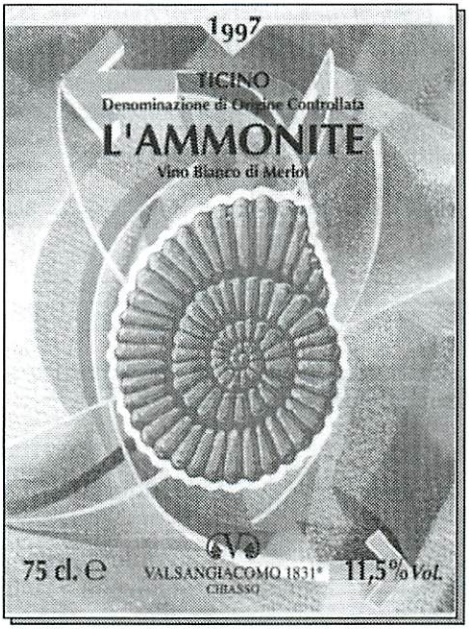
This is of partcular interest to me as our daughter and family live 200 miles north-west of Winnipeg off the flat land which extends about 50 miles from Winnipeg in that direction. Perhaps an article on Agassiz might be an idea.

Yours,

Alyn Jones

Well, perhaps an article on Louis Agassiz might be an idea. David Land referred to his tour of Scotland in the last issue and Mike Taylor makes mention of his visit in relation to Hugh Miller's fossil fish localities and collections. Are there any volunteers?

Geo-vineyards



Tasting Notes

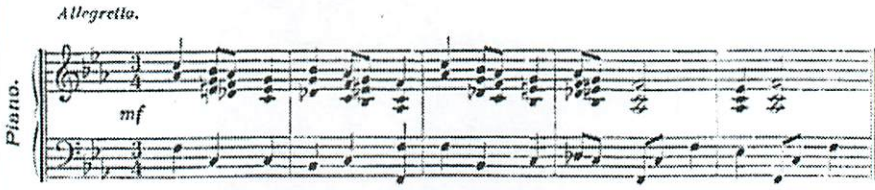
An interesting wine whose provenance is clearly of less importance than its palaeontological antecedents. The nose suggests a clean open marine environment with fresh Middle Mesozoic overtones. The bouquet is calcareous though there is a sharp suspicion of aragonitic replacement. But it is the finish that is outstanding, being best described as pearly to iridescent. What can I say? This must be the best possible accompaniment to shellfish, especially rather old shellfish.

Thanks to Cliff Porteous, who sent me this label, together with a spectacular label for the next issue. He should not be held responsible for the Tasting Notes however, and in fact tells me that L'ammonite, an Italian Merlot, is really a light and refreshing wine. I ask all readers to keep a sharp eye out during their summer holidays to wine-growing regions of the world!

Poet's Corner

The following song, sent to me by Averil Hope Smith, was composed in 1912 by Professor Maurice Lugeon of the University of Lausanne. It was published after an excursion to the northwest Highlands conducted by doctors Peach and Horne as part of the Dundee meeting of the British Association for the Advancement of Science. Averil has a copy with the music, should anyone want it!

La Chanson du Moine Thrust.



1

Si le Moin' Thrust avait voulu,
Le crois-tu?
Quand il sortit de sa racine,
Faire une croisière marine
Ou sur les terres s'élancer.
Quel horst eût donc pu l'arrêter?
Il aurait comblé l'Atlantique,
Si le Moin' Thrust avait voulu,
Le crois-tu?
Il eût étouffé l'Amérique!

2

Si le Moin' Thrust avait voulu,
Le crois-tu?
Mettre en fenêtre la Bretagne,
Couvrir en France les montagnes,
Barrois n'y eût plus rien compris
Et Haug aurait été ravi
De nous conter dans ses grimoires,
Si le Moin' Thrust avait voulu,
Le crois-tu?
Une aussi palpitante histoire.

3

Si le Moin' Thrust avait voulu,
Le crois-tu?
Couvrir les nappes glaronnaises
Et mettre donc Heim à son aise,
On eût ainsi vù pli sur pli,
Quel mècanisme! mes amis,
Puis poursuivant sa route altière
Si le Moin' Thrust avait voulu,
Le crois-tu?
Il couvrirait la terre entière.

4

Si le Moin' Thrust avait voulu,
Le crois-tu?
Pousser sa marche avec furie,
Bondir sur l'Autriche et Bosnie,
Il serait sur les noirs Balkans,
Et Tietze serait sur les dents,
Son K. K. aurait trop à faire,
Si le Moin' Thrust avait voulu,
Le crois-tu?
Saisir l'Autriche par derrière!

5

Si le Moin' Thrust avait voulu,
Le crois-tu?
Tout laminer sur son passage,
Porter la Suède au bord du Tage,
La Suisse au bord de la Néva,
La Russie en l'Himalaya,
La Chine au lieu de l'Allemagne,
Si le Moin' Thrust avait voulu,
Le crois-tu?
Partout serait la Grand'-Bretagne.

6

Si le Moin' Thrust avait voulu,
Le crois-tu?
Il monterait jusqu'aux étoiles,
Car accompagné par les voiles
De tous les vaisseaux des Anglais,
Qui donc arrêter l'oserait?
De la Terre, vaste cymaise.
Si le Moin' Thrust avait voulu,
Le crois-tu?
La Lune serait écossaise.

7

Non, le Moine n'a pas voulu,
Le crois-tu?
Poursuivre sa route lointaine,
Car Peach avec sa panse pleine
Etait un peu lourd à porter,
Le Moine aima mieux s'arrêter,
Ne voulant dépasser ses bornes.
Non, le Moine n'a pas voulu,
Le crois-tu?
Attrister le bon docteur Horne.

8

Non, le Moine n'a pas voulu,
Le crois-tu?
Quitter son beau pays d'Ecosse
Pour aller chercher plaies et bosses
Sur de trop vieux horsts inconnus,
Il y serait arrivé nu,
Perdant toutes ses «pipes» en route.
Non, le Moine n'a pas voulu,
Le crois-tu?
Du bon whisky perdre une goutte.

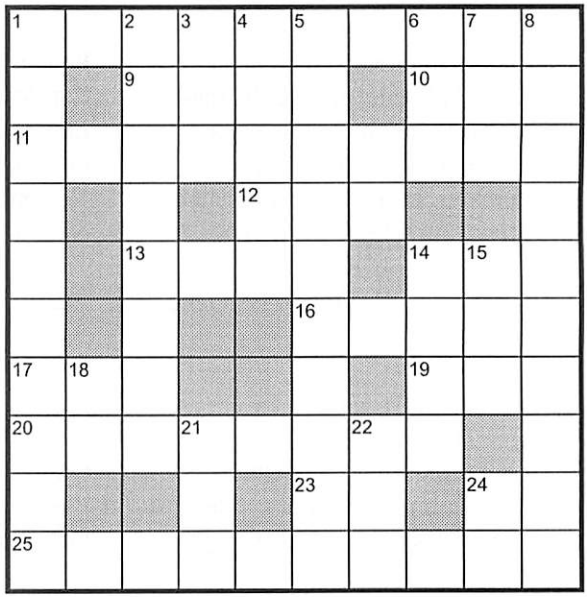
9

Non, le Moine n'a pas voulu,
Le crois-tu?
Quitter son pays de tourbières,
Porter trop loin ses belles pierres,
Et nous avons pu l'admirer,
Et nous pouvons nous en aller
Avec une démarche fière
Non, le Moine n'a pas voulu,
Le crois-tu?
Laisser à d'autres ses bruyères.

I imagine that this is rather humorous... can anyone like to translate it for us?

Rocksword Puzzle No. 7

compiled by Angela Anderson



Clues across

1. I chop board for fossil shellfish (10 letters)
9. Earth's satellite (4)
10. Is in beware, plurally (3)
11. Liberate good building materials (10)
12. More than 9 but less than 11 (3)
13. Push oar in hard frost (4)
14. Baba's first name in a line (3)
16. Law of male succession rich in silicon and aluminium? (5)
17. Donkey in Assynt (3)
19. 'The lowing herd wind slowly o'er the ---' (Gray's Elegy) (3)
20. Tilt a toy over for a complete eclipse (8)
23. A small company (2)
24. Elevated railway in USA (2)
25. Sounds like circumspectly separate (10)

Clues down

1. A brief duct split in two (10)
2. 'When a soft and purple mist like a vaporous --------' (P B Shelley) (8)
3. Sounds like a small company in the glen (3)
4. Shot round a plant (5)
5. Tern cities around a small space (10)
6. Collect 7 down in a pot... (3)
7. ... or even in 6 down (3)
8. Badly spice contemptibly (10)
14. In fall yet a friend (4)
15. Do not sit on an untruth (3)
18. Thus (2)
21. Part of the Arctic Circle (3)
22. To take in a wee dram (3)
24. as 24 across (2)

This is Angela's seventh puzzle, which she tells me is less obscure than those in the past, though 20 across might seem obscure to some! For those who find it all too obscure, the answers can be found inside the back cover of this issue.

Proceedings of the Edinburgh Geological Society for the 167th Session 2000-2001 No. 31

Compiled by David Land

Membership

The total membership of the Society at 30th September 2001 was (with last year's figures in brackets) 560 (570) consisting of:

Honorary Fellows	6	(7)	Senior Fellows	39	(24)
Corresponding Fellows	13	(12)	Family Fellows	33	(35)
Life Fellows	20	(18)	Glasgow Associates	13	(13)
Ordinary Fellows	443	(452)	Junior Associates	13	(9)

Deaths With great regret we have to record the deaths of Honorary Fellow Professor Sir Kingsley Dunham FRS, FRSE, of Corresponding Fellow Professor Brian Sturt of *Norges Geologiske Undersokelse* in Trondheim and of Dr John L Roberts.

Council elected 22nd November 2000

President: John H Hull

Vice-Presidents: David Stephenson, Thomas S Kerr

Honorary Secretary: J Michael Dean

Honorary Treasurer: David Gould

Membership Secretary: Mary M Leitch

Excursions Secreatry: A David McAdam

Lectures Secretary: Donald I J Mallick

Assistant Secretary: D Ian Jackson

Assistant Secretary (Billet): A Caroline Paterson

Proceedings Editor: Alan Fyfe

Librarian: Robert P McIntosh

Publication Sales Officer: David H Land (Emrys R Phillips from April 2001)

Scientific Editors: Philip Stone, Peter G Hill

Ordinary Members of Council: Diane H Mitchell, Robert L Reekie, Christine L Thompson, Tom B Wilson (2 vacancies unfilled)

Trustees: W D Ian Rolfe, William E Harper, S Ian Hogarth

Independent Examiner: Dalgliesh & Tullo, Chartered Accountants

Lecture Meetings were held as follows:

11th October 2000	**Prof Ben Harte**: Geology and scenery in Japan
25th October	**Mr Ken Hitchen**: The UK Rockall continental margin, its structure, volcanic history and potential for oil
8th November	**Dr L Anderson**: The Rhynie Cherts, a window on the earliest terrestrial ecosystems
22nd November	**Prof D A Davidson**: The sustainable use of soils (followed by the Annual General Meeting)
6th December	**Dr D I J Mallick**: Vanuatu, a drifting island arc
17th January 2001	**Dr D A Rothery**: The geology of Jupiter's satellites
31st January	**Prof M B Hart**: Global climate change, a geological perspective
14th February	Fellows Night
28th February	**Prof B J Upton**: Ancient volcanoes and Greenland's icy mountains (Prof Upton was presented with the Clough Medal at this meeting)
14th March	**Dr S J Cribb**: Whisky and water, the essence of Scotland
28th March	**Mr J H Hull**: Presidential address: Environmental geology, the marine dimension
	Average attendance at lecture meetings was 68

The **Clough Medal** was awarded to Professor Brian Upton for his extensive work on Scottish igneous petrology.

Publications

The *Scottish Journal of Geology* vol 36 part 2 and vol 37 part 1, and *The Edinburgh Geologist* nos 35 and 36 were published this year. The leaflet *Discovering Edinburgh's volcano* was reprinted with minor corrections and better graphics. The *Ballachulish Guide* was in press at the year-end.

Field Meetings were held as follows:

28th April 2001	**Rosalind Garton**: Stannergate and Errol Brickpit
9th May	Newtongrange Mining Museum
19th May	Hunterian Museum and Fossil Grove
6th June	**Norman Butcher**: Roseburn to Dean Village
16th June	**Dr Suzanne Miller**: Strath Fionan and Schiehallion
23rd-25th June	**Dr Grahame Oliver**: Stonehaven
4th July	**Tom Wilson & David McAdam**: Craigie Quarry
7th July	**Colin MacFadyen**: Blackness, Bo'ness and Birkhill
18th July	**Dr Suzanne Miller**: Granton Research Centre
11th August	**David McAdam**: Dunbar
8th September	**Dr David Stephenson**: Holy Island and Bamburgh
6th October	**Richard Batchelor**: St Andrews

Lothian and Borders RIGS Group

No new Regionally Important Geological Sites were designated, but efforts were concentrated on producing interpretive posters for sites already designated. Leaflets were produced for Corstorphine Hill and Petershill Reservoir Quarry. The RIGS Group officers were Mike Browne (chairman), David McAdam (secretary) and Cliff Porteous (treasurer).

Library

The Society's library was moved from the Grant Institute to the Robertson Science and Engineering Library (still in King's Buildings).

Accounts

A summary of the accounts for the year ending 30th September 2001 follows

REVENUE ACCOUNTS FOR THE YEAR ENDED 30th SEPTEMBER 2001

	General	Publications	Clough	Mykura	Total	
					2001	2000
INCOME	£	£	£	£	£	£
Gross income from investments	1,486	762	546	144	2,938	3,229
Net gain (loss) on disposal of investments	373	192	137	36	738	(538)
Bank interest	164	84	61	16	325	337
Subscriptions	7,269	-	-	-	7,269	6,297
Tax recoverable on Deeds of Covenant	961	-	-	-	961	518
Legacies and donations	1,326	-	-	-	1,326	145
Social evening	80	-	-	-	80	100
Sales of publications	-	3,882	-	-	3,882	4,957
TOTAL INCOME	11,659	4,920	744	196	17,519	15,045
EXPENDITURE						
Adminstrative Costs						
Printing, Stationery, Postage	215	(39)	18	-	194	293
Insurance	254	-	-	-	254	243
Bank charges	556	-	-	-	556	519
Miscellaneous	41	-	-	-	41	30
Printing of Laws, Roll and publicity sheet	170	-	-	-	170	-
Independent Examiner's fee	588	-	-	-	588	618
Depreciation	60	-	-	-	60	60
	1,884	(39)	18	-	1,863	1,763
Direct Charitable Activities						
Lecture costs	1,627	-	-	-	1,627	1,344
Priniting of billets	1,673	-	-	-	1,673	1,708
Postage of billets and Ed' Geologist	1,073	-	-	-	1,073	1,041
Award and Medal expenses	-	-	221	-	221	512
Excursions	1,537	-	-	-	1,537	1,440
RIGS Group	550	-	-	-	550	76
Scottish Journal of Geology	-	-	-	-	-	2,500
Edinburgh Geologist	-	1,211	-	-	1,211	1,100
Special Publications	-	(41)	-	-	(41)	1,919
Grants made	20	-	250	250	520	1,050
	6,480	1,170	471	250	8,371	12,690
Cost of Publications sold	-	3,122	-	-	3,122	3,624
TOTAL EXPENDITURE	8,364	4,253	489	250	13,356	18,077
SURPLUS (DEFICIT) for year	3,295	667	255	(54)	4,163	(3,032)

BALANCE SHEET AT 30th SEPTEMBER 2001

	2001		2000	
	£	£	£	£
FIXED ASSETS				
Investments at Market Value		63,640		76,447
Tangible assets		-		60
		63,640		76,507
CURRENT ASSETS				
Stock of publications	33,922		28,014	
Other stocks	698		775	
Debtors and prepayments	619		276	
Taxation recoverable	128		182	
Bank accounts	10,989		7,915	
	46,356		37,162	
Less				
CREDITORS REPAYABLE WITHIN ONE YEAR				
Sundry	1,312		810	
Scottish Journal of Geology	-		2,500	
	1,312		3,310	
NET CURRENT ASSETS		45,044		33,852
NET ASSETS		108,684		110,359
REPRESENTING				
FUNDS				
Permanent Endowment		52,543		54,561
Unrestricted		56,141		55,798
		108,684		110,359

prepared by David Gould, Honorary Treasurer

approved by Dalgliesh and Tullo, Chartered Accountants

adopted by Council on 22nd November 2001

Solution to Rocksword Puzzle No. 7

Clues across

1. BRACHIOPOD
9. MOON
10. ARE
11. FREESTONES
12. TEN
13. HOAR
14. ALI
16. SALIC
17. ASS
19. LEA
20. TOTALITY
23. CO
24. EL
25. DISCRETELY

Clues down

1. BIFURCATED
2. AMETHYST
3. COE
4. HOSTA
5. INTERSTICE
6. PAN
7. ORE
8. DESPICABLY
14. ALLY
15. LIE
18. SO
21. ARC
22. TOT
24. EL

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