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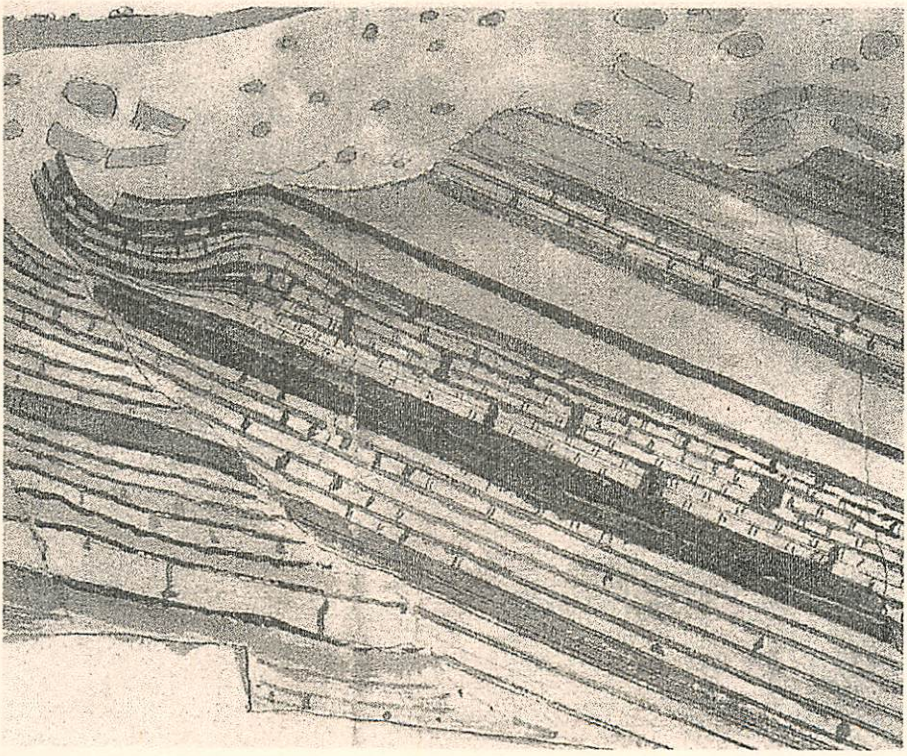
Issue No. 37 Autumn 2001



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Cover Illustration

The cover shows part a drawing by John Clerk of Eldin made during an excavation of Frederick Street in 1786 or 1787. Of particular interest is the use of the 'brick' symbol for well-bedded competent strata with prominent joints perpendicular to the bedding. See article entitled 'Brick-a-brack' on page 28.

The drawing is one of several belonging to Sir John Clerk of Penicuik and reproduced in facsimile in the folio entitled *James Hutton's 'Theory of the Earth': The Lost Drawings* by G.Y. Craig, D.B. McIntyre & C.D. Waterston, published in 1978 by Scottish Academic Press.

Acknowledgements

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Editorial

by Alan Fyfe

Breaks-through in geological (and other) sciences are often not recognised as such in their own time. As well as the short-sighted, there will always be the conservatives, the Doubting Thomases, the unbelievers and, worst of all, those who for political reasons, either personal or public, refuse to acknowledge such advances. Eventually, of course, the ideas become accepted and enter common credence... and then we wonder why everyone was so sceptical.

Take me – I do not believe that an asteroid striking the Earth led to the extinction of the dinosaurs. I don't think that it is because I am too short-sighted to espouse a new idea (though one that I feel has now regretfully gained general acceptance), it is simply that I am reluctant to embrace any ideology that smacks so much of catastrophism.

On this theme, in his article *The international significance of Agassiz Rock*, David Land writes about that notable landmark in Blackford Glen and how Agassiz's ideas on continent-wide glaciation were received by some as a break-through but by others with scepticism. As David says, Agassiz's contemporaries were being asked to replace a near-impossible Flood hypothesis with an equally impossible general refrigeration. The prevalent mechanism for glaciation is, of course, a blow for catastrophism, so I, for one, approve. And I thank David for his contribution.

And talking of general refrigeration, what's all this about Snowball Earth? This is a theory that suggests that in the late Proterozoic, planet Earth, including its oceans, was entirely mantled in ice. Call me a Doubting Thomas but... Anyway, this was one of the issues discussed at the Earth System Processes Conference held in June of this year in Edinburgh, though sadly not in any of the sessions covered by Nick Golledge, Sarah Arkley & Charlotte Vye in the brief review of the conference, a review that they gallantly agreed to put together despite a preposterously short time-scale imposed by me. I am indebted to them for their efforts.

John Hull, in his Presidential Address to the Society earlier this year, talked of the reluctance of politicians to take responsibility for managing the offshore environment. I am grateful to John for elaborating on this head-in-the-sand approach in an article for this magazine. The reluctance to acknowledge that there is a problem is worse because that reluctance is politically-driven.

In *A caseful of correspondence*, I hear from three Corresponding Fellows. At least their achievements have been acknowledged in their time – and they have been

Editorial

honoured for them. It was not so with William Smith, who receives acclaim today but had little in his own time. Two of our book reviews are on new biographies of this 'father of English Geology'. The other book review tells of a love affair... Thanks to Andrew McMillan, Norman Butcher and David Land for these. And thanks to Radvan Horný, Peter Wyllie and Robert Dott for corresponding with me.

And of course I am grateful to Angela Anderson for her latest Rocksword and to David Land (again) for submitting a song by Alexander Rose for our Poet's Corner, as well as for drafting the request for suggestions from Fellows on a new design for the Society's Diploma. Does anyone else share with me the notion that David may be having a clear-out?!

In the last issue, I had to apologise because I had found the song *Jointing* to include in Poet's Corner, but had completely mislaid the covering letter. I am grateful to Robert Dott for writing to me from Wisconsin and letting me off the hook. At the same time, Donald McIntyre wrote to me to tell me that it was to Robert Dott that he had sent the tune for Gilbert Wilson's song. Donald also filled me in on some details of the use of the brick symbol for limestone and I here thank him for his interest and correpondence on both topics.

Anyone wishing to send me anything for the next issue (and I am happy to receive brief contributions as well as full-length articles) should write to me at the address below. At the time of going to press, I am having a little trouble with my e-mail service provider, so please could you phone before sending me anything electronically — I hate to think of anyone's efforts being left floating somewhere in e-space. The copy date for the next issue is St David's Day, 1st March, 2002.

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The international significance of Agassiz Rock

by David Land

Last April I had the pleasure of leading a Science Festival excursion to the Hermitage of Braid and Blackford Hill, in the course of which Agassiz Rock in Blackford Quarry was visited, and its international significance explained. Unfortunately this significance is not mentioned or even implied on the commemorative plaque placed on the rock in 1993 by Scottish Natural Heritage, nor was it mentioned in the two previous plaques that had been put up there.

The wording on the current plaque is as follows:

> In 1840 Louis Agassiz, a Swiss geologist, first noticed that this rock was polished and grooved by the passage of an ancient glacier across its surface. His observation helped to lay the foundation for our understanding of how glaciers have shaped the landscape during the ice ages of the last two million years.

The earliest plaque was fixed on a post just in front of the rock, in about 1920, by our Society. It read:

> In 1840 Charles Maclaren showed this scratched and polished rock surface to Agassiz who exclaimed "That is the work of ice."

Some time about 1960 a second plaque was put up, also by the Society (the earlier one having disappeared), which read:

> Agassiz Rock. In 1840 Louis Agassiz Swiss Geologist stated that this rock was polished and grooved by ice during the great ice age.

As an example of ice action in smoothing, striating and (in this case) undercutting the crag, Agassiz Rock is a good example, clear and interesting. But better sites abound in Scotland, many of which were seen by Louis Agassiz in his 1840 visit. What makes the Blackford Quarry rock face so important and significant, not merely locally or even nationally, but internationally, is that it marks the first recognition in the world of the reality of former ice sheets where now there is no ice.

It is often forgotten how revolutionary was the Agassiz hypothesis of an ice age with countrywide, if not continent-wide, ice sheets: a revolution in geology on a par with plate tectonics. We are now so familiar with the concept of an ice age that it takes some imagination to realise that, before the work of Agassiz, the concept had not even been thought of. Apart from valley glaciers, all the phenomena such as

boulder clay, roches moutonnées, erratics, eskers, kames and striated bedrock, which now we recognise as due to ice action, were then ascribed to catastrophic floods with rushing waters thousands of feet deep. This near-impossible idea was only acceptable by appealing to scriptural warrant in Noah's flood.

Louis Agassiz (1807–1873) was born in northwestern Switzerland, at Motier. He is reported to have had a charming personality, radiating optimism and friendship. Being fluent in six languages helped his studies at Lausanne, Zurich and Heidelberg. Following an invitation by the explorers Spix and von Martius to study their Amazon fish collections, he specialised in the study of fish, both fossil and living, becoming a world authority in this field.

This brought him to the attention of William Buckland (1784–1856) who, in 1813, was appointed Professor of Mineralogy at Oxford University and, six years later, Professor of Geology. He was one of the great eccentrics, but likeable, candid, good-humoured and free from prejudice. He emphasized the importance of the love of truth in unbiased, factual observations and the deductions to be made from these. In 1834, he invited Agassiz to study the fossil fish collections in Britain and in the course of this visit, he met Hugh Miller and studied his Old Red Sandstone fishes.

As a relief from fish, Agassiz spent some summer vacations exploring Swiss glaciers, where it was common knowledge that they did not extend as far down their valleys as formerly. The ice-free portion of the valley yielded ample evidence of former ice in smoothed and striated rock surfaces, erratics and moraines.

In 1838, Buckland visited Switzerland where he examined this glacial evidence in company with Agassiz, and quickly realised that he had seen similar evidence in ice-free Scotland. When Agassiz was told this, he made the crucial intellectual leap from mere valley glaciers to the idea of countrywide or even continental scale ice sheets.

Buckland quickly accepted Agassiz's thesis, probably with great relief after trying to explain the evidence by appeal to impossibly great floods. As one wag put it:

> All was darkness once about the flood,
> till Buckland rose and made it clear as mud.

Two years later, in 1840, Buckland invited Agassiz to Scotland for the British Association for the Advancement of Science meeting in Glasgow, where Agassiz gave papers on ice and on fish. Afterwards, the two friends toured the country through Argyll, the Great Glen and eastern Scotland, everywhere noticing the evidence of ice action.

At Fort Augustus on October 3rd Agassiz wrote a letter to Professor Jameson in Edinburgh outlining his theory of a former ice sheet countrywide across Scotland, for publication in the *Edinburgh New Philosophical Journal.* As the current number had just gone to press, Jameson, who was sympathetic to Agassiz's idea, and immediately recognised the significance of his theory, passed the letter to Charles Maclaren, editor of *The Scotsman* and amateur geologist, who published it on October 7th, not only appreciating its geological significance but also that it gave him a fantastic journalistic scoop as first with news of this revolutionary theory. If Agassiz was right then centuries of belief in diluvial theories based on Noah's Flood had to be abandoned: one of the most telling blows against science's reliance on scriptural evidence.

Meanwhile, Agassiz continued his tour, eventually reaching Edinburgh. Maclaren and other Scottish geologists on 27th October took Agassiz to see various smoothed and striated rock surfaces on Salisbury Craigs, Castle Rock, Craigleith Quarry, Corstorphine Hill and finally Blackford Quarry where, Maclaren records, 'we accompanied M. Agassiz [round Edinburgh]; he had expressed doubts as to some other supposed marks of glacial action near this city, but on seeing those at Blackford Quarry, he instantly exclaimed, "That is the work of ice!" '

Despite Agassiz's international standing, it took nearly twenty years before his ice-sheet theory became generally accepted. In fairness to Agassiz's critics, they were, as they saw it, being asked to replace a near-impossible Flood hypothesis with an equally impossible general refrigeration. And it must also be remembered that in the mid-nineteenth century no geologist had studied either the Greenland or Antarctic ice sheets.

Studying Swiss glaciers with Buckland and hearing about the ice-action evidence in ice-free Scotland was the catalyst for Agassiz's concept of extensive ice sheets, and prompted him to make his 1840 tour which finished in Blackford Quarry. So the international significance of this spot is not in its being yet another, though good, example of ice-scratched and smoothed rock, but that it marks the first recognition in the world of the reality of former ice sheets where now there is no ice.

David is well-known to Fellows of the Society as a long-standing member of Council and was President of the Society from 1995 to 1997. He is a member of the Lothian and Borders RIGS group and was the author of the Society's leaflet on the Hermitage of Braid and Blackford Hill.

Earth System Processes Conference

by Nick Golledge, Sarah Arkley & Charlotte Vye

In June of this year, a scientific conference was held in Edinburgh, convened jointly by the Geological Society of America and the Geological Society of London. It was held in the rather grand surroundings of the new Edinburgh International Conference Centre and delegates came from far and wide to listen to the speakers, to take part in the excursions and to enjoy Edinburgh's June weather. The Edinburgh Geological Society helped with the organisation and ran a book store throughout the four days of the meeting. The following is a brief review by three British Geological Survey staff who attended a couple of the days.

This conference, described in the registration brochure as 'a global meeting', was designed to offer a holistic, interdisciplinary approach to understanding the way in which the Earth has evolved and to predict future change. It embraced many specialist fields and to describe it fully would take up several issues of this magazine. The Volume of Programmes with Abstracts runs to no less than 136 pages and readers who are interested would find it well worth dipping into. Copies are available in the BGS Library, Murchison House.

The following account represents impressions of just of two of the 58 sessions. These covered the highly topical issues of climate change in the Quaternary and global environmental change in the Late Palaeozoic. The application of modern research techniques to study change on different time-scales is vital to aid our understanding of how the Earth works. The predictable headline-driven press coverage – 'Did a planetary wobble kill the dinosaurs?' *New Scientist*, 28th June 2001, 'Could a Seismic Fault Account for Loch Ness's Mysterious Monster?' *Scientific American*, 27th June 2001*, and similar stories in the daily newspapers at least advertised the conference. For the scientists attending, it achieved the aim of bringing together specialists from a wide range of disciplines to analyse past and emergent Earth surface processes.

Day 1 – 25th June

After introductions to *Life on Earth* and *Earth Systems* from Aubrey Manning and Geoffrey Boulton during the plenary session, Session No. 5, *Causes of rapid climate change in the Quaternary* got underway. Mark Maslin of University College, London presented a well-informed summary of the nature of climate transition during the Quaternary and the problems that can be encountered in this

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* for details see website www.geosociety.org/meetings/edinburgh/index.htm

field. The idea of climate transition thresholds was discussed, and the principle of 'bifurcation' in climate responses. The resultant non-linear relationships mean that climate changes are unlikely to reverse in the same way as they originally occurred. Problems of spatial and temporaral scale were addressed, and was linked to interactions of tectonics, atmospheric gases and orbital forcing mechanisms.

A number of speakers continued the theme, highlighting particular aspects of Quaternary climate change. William Hay of the GEOMAR Research Centre, Kiel, presented more detailed assessments of factors such as Carbon 4 plants and their impact on atmospheric CO_2 and aridity; tectonics such as Cenozoic uplift of the Tibetan plateau; and volcanic emissions. G.H. Haug of ETH, Zurich, presented El Nîno data from tropical South America with a discussion of worldwide climate impacts of the southward migration of Inter-Tropical Convergence Zone. Thermohaline circulation in the North Atlantic and its control on mass ice-rafting events such as Heinrich 1 was dealt with by Michel Crucifix of the Universite Catholique de Louvain, whilst Gideon Henderson of Oxford University presented U/Th midpoint dates for the last three major deglaciations, based on carbonate sediments from the Bahamas.

During the afternoon session, *Fragile and hazardous environments*, two speakers, Magnus Gudmundsson of the University of Iceland and Andrew Russell of Keele University, spoke on Icelandic jökulhlaups. Gudmundsson focussed on fundamental processes and environmental impacts whilst Russell presented data suggesting the common occurrence of large-scale ice-fracturing and englacial sediment depostion during these events. Mary Chapman of the USGS used such Icelandic phenomenon as an analogue for Martian landsystems observed in images from the most recent Mars Orbiter Mission. Outlet canyons of jökulhlaups on the Martian surface appear to extend for up to 3000 km.

Posters for each of the sessions were on display throughout the day. Of particular interest were posters from Katherine Leonard of Portland State University and Jeremy Everest of Edinburgh University, both of which demonstrated new Quaternary techniques. Leonard presented a technique for the micromorphological study of unconsolidated aeolian sand using surfboard resin for the preparation of thin sections. After *in situ* impregnation and a curing time of one or two days, the sediment is then removed from the field locality with a greatly reduced risk of damage. However, it may only be successful in fully dry, unconsolidated coarse-grained material, and may not be so useful in wet sediments or silt and clay-rich tills. Everest presented results of cosmogenic dating of boulder surfaces from moraines in the Cairngorms. Large errors in the dates reflect the high number of

corrections that need to be made with this technique, but those presented at least provide a 'ball-park' figure for deglaciation of Gleann Einich and the surrounding area of around 16 000 to 14 500 years BP.

Day 2 – 26th June

In the plenary session *The geological consequences of evolution* Andrew Knoll of Harvard University discussed the effects of the environment on evolution and vice versa. This concept was developed with the modern interaction between humans and the environment as we alter our environments to suit our own physiology. The consequences of such interactions are to alter evolution as well as the environments around us.

In Session No. 25 *Global change in the Late Palaeozoic*, Chris Scotese of the University of Texas presented 3D palaeogeographic reconstructions of Late Palaeozoic continents and ocean basins. This proved to be a stimulating and animated discussion of current global reconstructions. It got off to a lively start with inflatable balls representing different epochs within the Palaeozoic being dispersed amongst the audience. Presentations of working palaeo-digital elevation models from five dates within the Late Palaeozoic followed, and Chris tackled current palaeogeographical controversies such as the timing of the North American continent crossing the equator during the Devonian and Carboniferous.

A number of speakers discussed the analysis of isotopes and their relationship to environmental change. Topics included isotopic whole rock and organic carbon trends in relation to environmental cycles and events. Werner Buggisch of the Univeristy of Erlangen concluded that the $\delta^{13}C$ isotope curve can be correlated to the sea level and to (bio-)events in Europe. However, further investigation is required from this research to assess if the shifts in the isotope curve are global. Using evidence gathered from two basalt flows of different ages Robert Berner of Yale University suggested that the rise of trees and vesicular plants around 360 Ma coincided with a rapid decrease in CO_2 due to a rise in weathering and the burial of organic matter. Matthew Saltzmann of Ohio State University studied the Carboniferous sequence in the Arrow Canyon Range in Nevada to indicate the transitions between Greenhouse and Icehouse phases. The patterns of the carbon curve may be controlled by the effect of glaciation on sea level. $\delta^{13}C$ values are seen to increase throughout the Carboniferous with an anomaly in the earliest Carboniferous. Based on numerous comparisons from North America and Belgium, this shift is apparently global, and may be linked to the closing of the Euramerican and Gondwanan gateways. Ethan Grossman of Texas A & M

University analysed carbon isotope variation in brachiopod samples from the Russian Platform, North America and Australia. Although the quality of the data was debatable, the main conclusions were:

- in continental USA, $\delta^{16}O$ may reflect regional salinity variations, especially during the early Carboniferous;
- there is evidence for coupling between the Carbon cycle and the Permo-Carboniferous palaeoclimate.

Neil Tabor of the University of California looked at the effect of a very large continental mass such as Pangaea on atmospheric circulation, the build-up of latent heat and pressure zones across the continent from palaeosol data. The temporal trend towards enriched isotopic values across the entire region indicates a long-term shift towards a progressively more arid climate through the Early Permian. Isabel Montanez of University of California discussed the rapid rise in pCO_2 in the Permian and Triassic derived from palaeosols and pedogenic minerals. The pCO_2 curve generated indicates possible oscillations in precipitation and climatic variations that may be linked to ice sheet dynamics. Harald Strauss of WestfalischeWilhelms-Universität Münster, Germany, described biogeochemistry in the Late Palaeozoic using evidence from sulphur isotopes to investigate to what extent the growth, development and evolution of land plants affected sulphur values between the Devonian and Permian.

As can be seen, the conference provided a forum for a wide range of presentations. Another topic that commanded much interest was the Snowball Earth Theory, but the ice was broken early in the conference at the beer and poster sessions. Although the consequences of the Foot and Mouth epidemic put paid to most of the planned excursions, some enjoyed the volcanic delights of Arthur's Seat made even more dramatic by a local thunder storm.

Acknowledgement

This review is published by permission of the Director, British Geological Survey (NERC).

The authors are all based at BGS in Murchison House and work on several projects within the Integrated Geoscience Surveys (North) Programme. Nick applies his expertise in Quaternary mapping projects in the Solway area, Caithness and more extensively in the Cairngorms. Sarah and Charlotte are currently involved in revision mapping of both urban and rural parts of Ayrshire and northeastern England. All three have interests in environmental geology and the interaction between geological processes and land-use.

Environmental geology – the marine dimension

by John H. Hull

Several Fellows have asked whether it might be possible for the Presidential Address, presented by John Hull on 28th March 2001, to be published in THE EDINBURGH GEOLOGIST. *The following paper is based on that Address.*

Introduction

The concept of environmental geology was formulated in the early 1980s, as were the development and application of techniques concerned with environmental geological mapping to assist land-use planners. Several members of this Society were closely associated with developments at the time. Given the growing physical exploitation of shallow seas and their underlying rocks, it was recognised in the 1990s that similar 'planning' issues obtained offshore, in particular that the sensitive coastal zone required a multi-national, holistic approach. The immediacy of such issues and the general lack of public awareness is highlighted as recently as July 2000 in papers prepared by a Royal Commission Study on Environmental planning **in which the marine dimension continues to be ignored.**

Background

Many environmental projects are concerned with the determination of palaeoenvironments and their associated palaeoclimates by way of multi-disciplinary studies of the geological record. From the 1980s onwards, such studies have become increasingly concerned with the interaction between the world's peoples and Earth processes. Bearing this in mind, a useful general definition of 'Environmental Geology' is that proposed by McKelvey (1983), in which three elements are recognised:

1. the preservation of human health and safety - from a geological standpoint, this might include the identification of potentially naturally hazardous areas prone to earthquakes, volcanicity, landslides, flooding and so on. Additionally, there are areas at risk due to man's activity, for example petroleum exploration causing gas blow-outs (e.g. in Borneo and Nigeria), and undermining (e.g. in Glasgow).

2. the preservation of the quality of the human environment - this category might involve studies concerned with the safe disposal of household and radioactive wastes, the protection of water supplies and the environment from industrial dereliction and pollution arising from various mining, agricultural and construction industry practices;

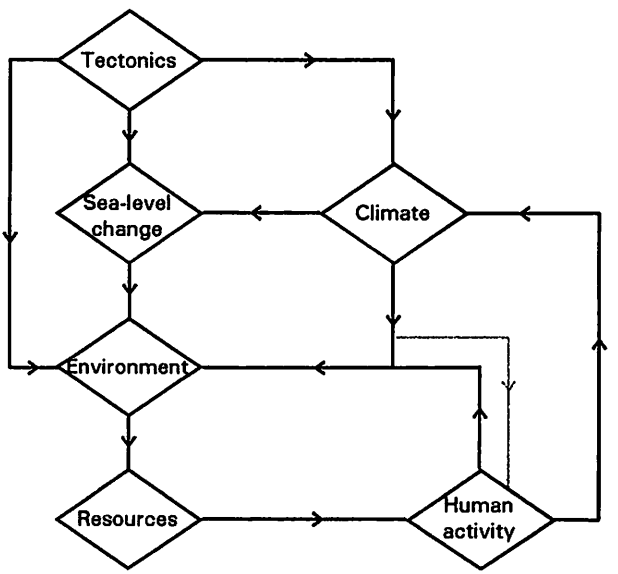
3. the facilitation of the wise use of land and its resources - it is a consideration of this element that led the then Department of the Environment in England and Wales and the Scottish Development Department (SDD) in Scotland to commission a whole range of mineral assessment studies, followed by more wider-ranging, thematic geological mapping projects (environmental geology maps) concerned in addition to minerals with ground engineering conditions, stability, undermining, opencast activity, hydrogeology and other topics considered relevant to the formulation of sensible land - use planning policies by national government and local authorities.

A prototype project was undertaken near Glenrothes, Fife in which eighteen element maps, four derived maps and five environmental potential maps were prepared and the results applied to a number of hypothetical land-use scenarios.

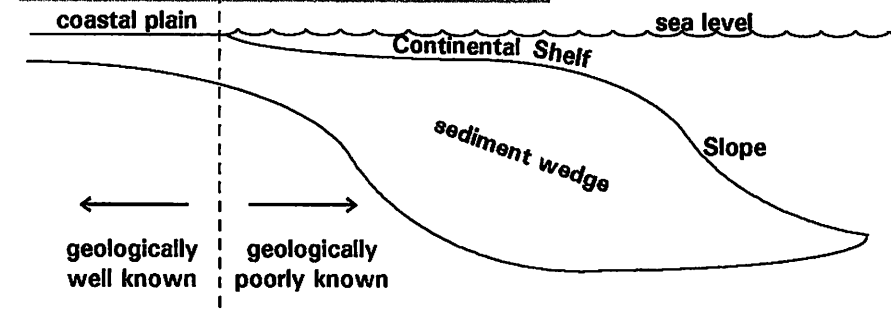
Even in these early days the SDD recognised that some land-use planning requirements would require an offshore component. As an example, the sea bed around the Shetland Islands was characterised by Nigel Fannin to identify potential pipeline routes into the islands from the west.

Interactions between onshore and offshore areas

The boundary between the onshore and offshore environments is always transitory, moving as it does in response to changes of sea level. Some of the inputs and feedbacks involved in sea-level change are summarised in the so-called SETR mechanism, this diagram might in my opinion also have included a link (shown in grey opposite) between climate and human activity with a feedback to the environment.



SETR diagram
Sea-level—Environment—Tectonics—Resources



This schematic section across the onshore–offshore boundary shows a sedimentary wedge increasing in thickness from beneath the coastal plain out to the shelf edge. It is within this wedge that many of the natural resources prized by society are located, ranging from sand and gravel and valuable metalliferous placer deposits inshore, to accumulations of oil and gas in the the thicker sequences beneath deeper waters. With the low gradients involved, it is the coastal zone just above and below high-water mark that shows the greatest areal response to changes in sea level and consequent environmental impacts such as flooding.

The exploitation of shallow seas

The shallow seas and oceans have been exploited by man since time immemorial as sources of food and as highways to get around the globe. In particular the shallow seas are exploited because of their proximity to where most of the world's population has lived, and still chooses to live despite the hazards posed by tsunamis and longer-lived global sea-level change.

Although the shallow seas represent only 7.6 percent of the earth's surface, they provide many of the resources that are essential to modern civilisation:

Mineral resources - the most significant resources currently being recovered globally are of natural oil and gas. However, other minerals are obtained from offshore area by dredging (for sand, gravel and placer minerals), by mining (iron, tin, barite and coal), solution mining using boreholes (for potash, sulphur and salt) and coal gas (coal-bed methane).

Renewable energy - the sources of energy so far mentioned are finite, but there are renewable resources available, especially wind, wave and tidal energy. These are currently being developed and have not yet achieved their full potential, but they offer the possibility of clean environmentally-friendly energy production in the future.

Living resources - fishing is an ancient pastime off all coastal states. Increasing world population following the Second World War drove up the demand for protein which resulted at the time in an expanding fishing industry. Between 1955 and 1970, the world catch more than doubled from 30 to 70 million tonnes annually and has stayed at about this level ever since. This intensity has led to over-fishing in some areas and has resulted in damage to spawning grounds and fish stocks alike. Thus the future of this food resource has become a live commercial and political issue, with the forecast demise of the fishing industry in Scotland. Long-term planning and international agreement over fishstock management is, therefore, the cornerstone of future sustainable resource exploitation.

Construction activities - we are all used to seeing building sites, not least in Edinburgh at the present time, but in some ways the seabed may be considered as a large building site and associated dump and scrap yard. Before the advent of the offshore oil and gas industry, construction would have been limited to harbour developments, coastal defences and outfall pipelines. All these would have been in shallow water and employed techniques modified from those used on land. In recent years, construction has taken place in progressively deeper waters and the structures themselves have become ever bigger. With accommodation blocks and networks of distribution pipelines the seas and the seabed are becoming increasingly congested.

However, shipping lanes must be protected for leisure, commercial, military and future fishing use. Such activities also require lighthouses, navigational aids, mooring areas and docking facilities. Telephone and power distribution cables are important locally and each sterilizes a corridor of the seabed. In the future, structures concerned with wind, wave and, perhaps, tidal power will be constructed. Additionally bridges and tunnels need protection from other activities. Then there are scientifically important areas which need to be conserved, be they of geological interest, wildlife habitats (whales, dolphins, porpoises) or of ecological importance (e.g. cold water coral reefs).

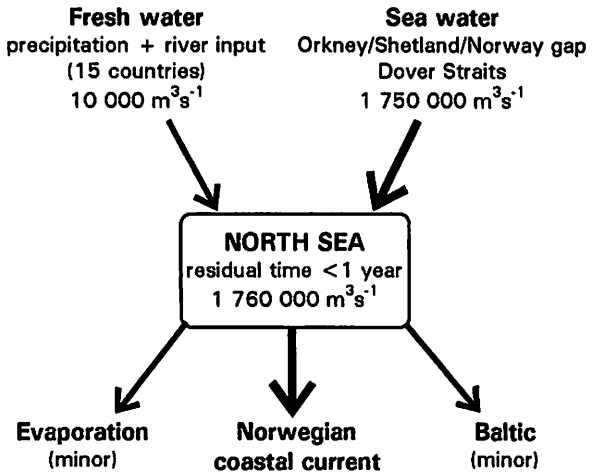
Waste disposal and Pollution - since the onset of industrialisation, coastal states have used shallow seas as dumping grounds for waste materials. Rivers and estuaries were the early focus for industrial development, they were dredged to increase access and the material dumped progressively farther offshore. They became conduits for waste discharges from factories on the river banks and sewerage was also discharged into their waters. Thus the

shallow seas came to be regarded generally as appropriate sites for the disposal of wastes which were not acceptable on land.

Within the eighties it became apparent that the capacity of some shallow seas to dilute and disperse contaminants had been exceeded. The effects of pollution on biota can be devastating. Some fish suffer genetic change, others become so toxic as to be inedible, for example off the Japanese coast where mercury pollution is high. Closer to home, the issue is highlighted by recent reports of problems with shell fish off the west coast of Scotland and with wild salmon contaminated by discharges from fish farms.

The North Sea

The North Sea may be used as a case study to summarise some of these issues.



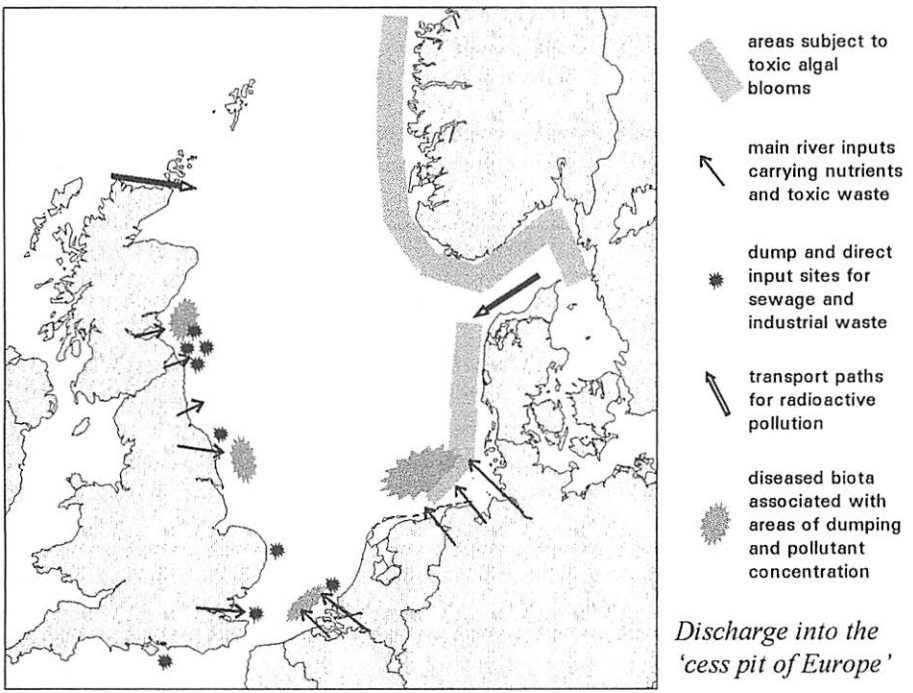
Water balance diagram (after Cook et al., 1992)

The water balance shows that the major sea-water input is mainly from the North, with a small freshwater input from the rivers of the 15 surrounding countries. The residence time is up to a year and the water exits as the Norwegian coastal current. The water circulation is principally down the eastern coastline of the UK, returning northwards from the entrance to the Straits of Dover along the western coast of mainland Europe. This circulation pattern has implications for the movement of modern sediments and pollutants.

Many of the mineral resources won from shallow seas worldwide are also taken from the North Sea, especially hydrocarbons. Additionally there are the various construction projects such as pipelines, harbours, power stations, wind farms, fishing, coastal defence, shipping and military uses. Given the level of development, an increasing problem will be acceptably to decommission many of the major oil and gas platforms and to clear the adjacent seabed of associated

structures. Historically, shipwrecks and defunct military installations have just been left in place and marked on the relevant navigation charts, but this is no longer an acceptable option.

The North Sea has been referred to in the Press as the 'cess pit of Europe' - with some justification as a number of areas are undoubtedly polluted. In many cases the pollution is localised either because of concentrated dumping, or because, as in the German Bight, the local current regime recycles pollutants to areas of muddy sediment where they are adsorbed on to the clay minerals.



Discharge into the 'cess pit of Europe'

Until recently the direct disposal of untreated, or partially treated, sewage was relatively common from coastal states, including the UK, Belgium, the Netherlands and Germany, together with contributions from inland countries via the major rivers of Northern Europe. As an indication the heavy metal concentration of UK direct sewage discharges in 1980 alone contained the quantities shown in the table at the top of the next page. In the same year the sewage also included some 180 kg of organochlorines.

METAL	TONNES
copper	78
lead	68
zinc	339
chromium	90
nickel	64
arsenic	10

Heavy metals in 1980 UK sewage discharges

In addition to direct discharge, waste was also dumped at sea legally until 1992, though by 1989 the UK was the only country still dumping sewage sludge into the North Sea. About 6 million tonnes were dumped in that year alone.

The incineration of highly toxic wastes (PCBs) at sea is still practised by Belgium, UK and Switzerland with annual disposal rates of about 95,000 tonnes. This method requires combustion efficiencies of 99.99%, but in the USA, doubts have been raised about the effectiveness of the method.

In addition to planned disposals of waste materials, there are, of course, accidental discharges, mainly of oil and chemicals. Annual discharges have been calculated as:

from ships	60,000 tonnes of oil and 2,800 tonnes of chemicals
from oil installations	30,000 tonnes

Catastrophic spillages from oil tankers such as the *Exxon Valdez* (1989) and most recently the *Jessica* are always possible. The former discharged almost 42,000 tonnes and the latter 571 tonnes of diesel and fuel oils respectively into the waters off Alaska and around the Galapagos Islands, and both received much media attention, because of the environmentally sensitive nature of the respective locations.

However, it is worth noting that the volume discharged is not necessarily related directly to the environmental damage caused. For example 14,000 tonnes were discharged from the *Erika* off the Brittany coast, but it caused the most damage to wildlife so far recorded. This is put down to the spillage coinciding with adverse weather conditions involving gale-force onshore winds.

Emergency plans are needed worldwide, but especially in areas such as the North Sea, where Rotterdam is one of the World's major oil ports and large tankers are coming and going on a daily basis.

In considering the pollution of the North Sea, an atmospheric contribution should not be forgotten. The annual input has been estimated at 626,000 tonnes, comprising nitrates, copper, lead and zinc, and about one-third of this input is calculated as coming from UK sources.

Small amounts of airborne radioactive waste are also carried into the North Sea, mainly from coastal power stations and reprocessing plants, supplemented from time to time by fallout from nuclear weapons testing and disasters such as occurred at Chernobyl.

The results of all these different types of pollution are obviously manifested on dirty beaches and seas in which it is not safe to bathe. Less obvious is the damage to marine habitats in general and fish stocks in particular. Diseased, possibly mutating, fish are sometimes caught, and nutrient imbalances result in toxic reactions effecting plankton and shellfish stocks.

An ongoing problem with the North Sea is that the recovery time to conditions existing before the start of the industrial revolution in Europe remains unknown. To address this problem requires the establishment of compatible, inter-disciplinary databases, as well as legislation agreed between onshore planning authorities and offshore international agencies to avoid further damaging inputs.

Although projects have been in hand for sometime to remedy the former, for example NERC's Land-Ocean Interaction Study, they need to be funded for long enough to allow long-term trends to be determined. As to integrated planning, control and policing procedures, their formulation and acceptance seems to be some way off.

Legislative frameworks

Offshore, it has been written that the shallow seas are the common property of all its users, be they the resource exploiters, dumpers, recreational users, the military; cargo carriers or travellers. All concerned have legitimate rights to be there, and therefore acceptable procedures for resolving differences are a prerequisite for the good management of the seas.

Until the early 1970s everybody was legally free to do whatever they liked outside any country's three-mile limit, aside from a few regulations concerned with the safe passage of ships, oil and radioactive substances. Within it's own territorial waters, each nation did whatever it wished.

In 1972 this freedom on the High Seas was restricted by the Oslo Convention (and the similar London Convention which was applicable worldwide). Additionally, regional conventions were organised by neighbouring states with regard to pollution, this in recognition that the processes operating at sea are not constrained by arbitrary national boundaries.

The 1974 Paris Convention is a particularly important regulation, because it is concerned with marine pollution from land-based sources. It covers inputs via rivers and the atmosphere and has, therefore, a dramatic influence upon the industry of all countries of the European Union bordering on the North Sea and the Atlantic Ocean. Much of what happens at sea to-day is subject to EU directives, together with the targets implicit in the recommendations arising from inter-governmental meetings at Rio and subsequent venues. Nevertheless, the most recent meeting in the Hague on the impacts of global climate change on the environment still seemed unable to agree an acceptable, world-wide protocol for the control of CO_2 emissions.

Onshore, the responsibility for the initiation of onshore planning policies is led by governmental departments such as the Department of the Environment, Transport and the Regions and, in Scotland, the Scottish Executive as successor to the Scottish Office. The formulation of policies involves widespread consultation with interested parties, including local authorities, Scottish Natural Heritage (SNH), The Scottish Environmental Protection Agency (SEPA), academia and industry.

Usually any policy operates at, at least, two levels: the national and the local. The policing of the legislation would be undertaken by the Local Authorities, SEPA and/or SNH depending on the development proposed and its perceived impact on the environment.

Arising in 1999 from a Royal Commission on Environmental Pollution, a Royal Commission Study of Environmental Planning was initiated. The stated aims of this study are:

> to assess whether the various regimes at different levels for setting and achieving environmental goals provide an effective, accountable and transparent way of protecting the environment. Its scope goes much wider than land-use planning (although this aspect is central) and encompasses other planning regimes, such as those concerning pollution control, air quality, waste, agri-environment, and biodiversity.

Specific questions posed by the study relate to:

- environmental sustainability;
- administrative boundaries;
- integration or coordination of, or between, environmental planning regimes;
- subsidiarity and democracy (interpreted to mean delegation v. central control).

Concluding remarks

The shallow seas are exploited to underpin our standards of living. They provide energy, food, mineral resources and access to leisure pursuits, additionally they have been, and perhaps still are in some areas, used as waste dumps.

What happens at sea is governed by national and international agreements, whereas on land similar activities are controlled by national and local plans and procedures.

Importantly onshore, conservation and national park policies are either established, or in the process of being formulated, whereas in the coastal zone and offshore they are not highlighted to the same degree.

Fortunately, there is overall an increasing recognition by society and government of the importance of environmental matters. Nevertheless, it must be concluded that much remains to be done. The current Royal Commission Study is a welcome step forward, but, despite recommendations to the contrary, its papers issued as recently as July 2000 continue to ignore the marine dimension. In my view there has to be an integrated and holistic approach, especially in the sensitive and transitory coastal zone. Obviously, it is important to minimise the pollution entering our streams and rivers, but it is surely equally important to consider the estuaries, coastal zones and seas into which these water courses discharge.

So what is to be done? In my Presidential Address, I tried to make the Society aware of the issue. I will continue to make representations at every available opportunity that some consideration be given to the implications of onshore planning policies on offshore environments.

For your part you may bear these issues in mind in any relevant discussions you might have with any local councillors, MPs, MSPs, journalists and so on.

If we do not achieve an integrated policy, our enjoyment of coastlines, beaches and seas will be impaired and the marine environment degraded, not only for us, but also other mammals and organisms that share it with us. This is a prospect too awful to contemplate.

Acknowledgements

The development of environmental geological maps in the UK was largely pioneered by BGS, then IGS, and involved some members of this Society including Mike Browne, Andrew McMillan, Stuart Monro, David McAdam, Ian Cameron,

Andrew Aitken and Edmund Nickless all of whose contributions I gratefully acknowledge. Offshore, I am equally indebted to former colleagues including Howard Johnson, Eileen Gillespie, Ken Hitchen and especially Nigel Fannin. BGS's Alice Walker, Sue Loughlin, the Drawing Office and Photographic departments also rendered assistance in the preparation of the Addess.

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John Hull gave his Presidential Address to Fellows on 28th March 2001. He was also invited to give a similar address to the final-year students taking the 'environmental' option at Edinburgh University. He was Director of the British Geological Survey in Scotland from 1982 and head of the Petroleum Geology, Geophysics and Offshore Surveys Division from 1985, retiring from BGS in 1994.

Design a Diploma!

From time to time, the Society elects distinguished geologists as either Honorary Fellows or Corresponding Fellows, who, on election, receive the Society's signed Diploma. A facsimile of this is on the following pages.

The Diploma needs reprinting, if only to change the date, but Council thinks the opportunity should be taken to redesign and modernise the Diploma, and wishes to have members' views on this.

With the number of elections averaging only one in every two years, the print run is very small, but in these days of computer graphics and desk top publishing the small number is irrelevant and the scope for a new design is wide open.

A few questions to start the ball rolling:

Should the diploma be totally redesigned to a modern look?

Should the style remain the same, with copperplate and gothic lettering?

Should the size remain the same (nearly A3) or something nearer A4?

Should the layout be 'landscape' or 'portrait' style?

Should we continue to use heavy 'parchment' paper?

Should colour be used?

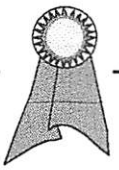
Should the wording be framed?

Should the Society's logo be included?

Please let Council have your ideas on diploma design, and if you can produce graphically a redesigned layout (even just a sketch) so much the better.

It should be mentioned that Council is considering changes to the laws governing the election of Honorary or Corresponding Fellows, but this will not obviate the need for new diplomas.

We currently have six Honorary and twelve Corresponding Fellows. At present, Law 3.2(a) states that 'the Society may confer Honorary Fellowship in recognition of merit or achievement in the science of geology or for service to the Society.' Law 3.2(b) states that 'the Society may elect as Corresponding Fellows persons of scientific merit or achievement resident outside the United Kingdom who by membership of the Society may be enabled or assisted to extend and foster links between the Society and the science of geology abroad.



Please put your ideas on paper for Council's consideration

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___Fellow of the Society

Diploma is signed by

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_____ } Vice Presidents.

_____ }

_____ Secretary.

Edinburgh _____ 19___

The Edinburgh Geological Society

at a Meeting held here _____

elected _____

_____ Fellow of the Society

In Testimony whereof, this Diploma is signed by

_____ President.

_____
_____ } Vice Presidents.

_____ Secretary.

A caseful of correspondence

by the Editor, based on contributions by
Radvan Horný, Peter J.Wyllie & Robert H Dott Jr.

With the recent election of Dr. Radvan Horný as a Corresponding Fellow of the Society, I decided that readers might be interested in hearing something about some of the distinguished scientists that have been honoured in this way. So I wrote to around half of the current Corresponding Fellows. The one thing that they would seem to have in common is that they are all very busy men – and yes, they are all men. That's another thing. Three of them have written back to me.

'Dear Mr. Fyfe,' wrote Radvan Horný from Prague, 'I have just found your letter (undated and still wrapped) in a pile of papers concerning our new exhibition devoted to the 150th anniversary of the birth of Professor O. P. Novák, our outstanding palaeontologist. According to the text, it must have been written prior to April (!). I deeply apologise for this embarrassing event, caused by my senile disregard and absentmindedness, enhanced by the preparation for the exhibition...'

Peter J.Wyllie, Emeritus Professor of Geology at the California Institute of Technology, Pasadena, was similarly apologetic. 'Dear Alan,' he wrote, 'I have just discovered, with a shock of guilt, your letter of 16th March within one of the stacks on my desk. Since I retired 2 years ago (at age 69), those stacks get higher and higher, and I forget more and more...'

And Professor Robert Dott from the University of Wisconsin wrote, 'With some embarrassment I confess that I accidentally lost an e-mail request for some anecdotal material from Corresponding Fellows of the Edinburgh Geological Society. I believe that the request came from you as editor of the Newsletter. Coincidentally, I had mailed a postal letter to you dated 9th January 2001...'

Ah yes, I remember now. It was Robert Dott who wrote to me with the words of the song entitled *Jointing*, written in 1926 by Gilbert Wilson when he was a MSc student at the University of Wisconsin (see Poet's Corner, Spring 2001). So it was **his** letter that I had mislaid when the last issue of THE EDINBURGH GEOLOGIST went to press! I thank him for writing to me and letting me know the source of the song, as well as forgiving me my own embarrassing lapse of memory. With all of us in the same boat, I look forward to hearing from the others in due course when my letters are exhumed from their epistolary stratigraphic piles.

Though his time for studies is 'rather limited' as he puts it, Radvan Horný has sent me a proposal for a couple of articles. In 1863, Professor Antonín Fric, director of

the Geology and Zoology Departments of the Museum in Prague, published a nice and catchy short article about Murchison's visit to Prague, containing some important paragraphs illustrating the political atmosphere in Prague at the time. He has offered to translate it and add a short introduction. He also writes that there are several of Murchison's letters to Jaochim Barrande from the years 1854–1863 in the Archives of the National Museum, and that it may be possible to reprint them together with a preface. I look forward to receiving and publishing these.

Peter Wyllie sent me his a load of paperwork, including a biographical summary, which he referred to as 'a first draft of source material for my obituary'. In 1948, he joined the Royal Air Force and there that he pursued the sport of boxing, earning the title of 1949 Royal Air Force (Scotland) heavyweight boxing champion. After serving in the armed forces, he attended the University of St. Andrews, where he earned his BSc in Geology and Physics in 1952.

The frigid climate of the East Neuk must have agreed with him because later that year, he was driving a team of huskies through the frozen, unexplored mountains in Dronning Louise Land, serving as an assistant field geologist with the British North Greenland Expedition. For the next two years, including two long, dark winters without sunlight, expedition members were isolated in the frozen arctic. For his rôle in the expedition, Wyllie received the Polar Medal from the Queen.

Wyllie returned to the University of St. Andrews, securing his PhD in 1958 and, having lectured there, also taught at Pennsylvania State University in the USA and Leeds University in England. He held the departmental chair at the University of Chicago before joining the California Institute of Technology in 1983. Here he was chair of the Division of Geological and Planetary Sciences for four years before returning to teaching and research. In 1994, he was appointed Division Academic Officer and served in this capacity until his retirement in 1999. In 2001 he received the Mineralogical Society of America's Roebling Medal, which is awarded for 'scientific eminence as represented primarily by scientific publication of outstanding original research in mineralogy.'

He has been honoured not only in his adoptive country (he became a naturalised American in 1995), but was also privileged to become a Foreign Member of the Chinese Academy of Sciences in 1996. His citation from the Academy tells of his accomplishments and describes him in characteristically flowery language as:

> an experimental petrologist of world renown, specializing in the effects of volatile components in melting relationships in synthetic and natural rock

systems under high temperature and pressure. His research is always directed toward processes in global tectonics, and addresses the problems by combining experimental petrology with geology and geophysics. His main achievements consist in research on magma genesis in relation to plate tectonics and the deep processes of the earth's interior, and the resultant conditions for mineralization. These are highly evaluated by geologists, geophysicists and geochemists all over the world, and have made him a leading figure in the international community.

But we should be proud of the fact that we got in there first, for it was in 1984 that the Edinburgh Geological Society elected him as a Corresponding Fellow!

Bob Dott, or Robert H Dott Jr., as he signs himself, tells me in his letter that he is a great grandson of Fyfe ancestry. Whether he and I are related or not, we have not yet discovered.

He also told me an interesting story relating to the recognition of the value of cross bedding for determining 'way-up' in metamorphic rocks. This method, he writes, was introduced to Britain by two young Wisconsin graduates in the summer of 1924 at Ballachulish in the northwestern Highlands. These lads were accompanying Norwegian Thorolf Vogt and they demonstrated to him why the Ballachulish succession must be upside down. This was contrary to E.B. Bailey's tentative interpretation of some ten years earlier. By coincidence, Robert Dott and a colleague stopped briefly at Ballachulish in 1963 after crossing on the old ferry in order to view briefly and photograph some cross-bedded quartzites. He says that at the time, he did not know the historical importance of those very same quartzites in the diffusion of knowledge of way-up criteria. He notes that these rocks have yet another historical importance in being cited by John Playfair among the evidence that the so-called Primitive rocks of the Highlands could not be truly primitive. His (Playfair's) friend James Hutton had argued that because they contained clastic rocks like these, which are composed of still older materials, then Highland rocks could not be wholly 'primitive'. Playfair also noted that such rocks elsewhere contained fossils, which also made them 'not strictly primitive'.

The recognition of way-up criteria by the two Wisconsin graduates receives some coverage in a recent article by Professor Dott, published in *The Geological Society of America Bulletin* for August 2001. The paper is entitled *Wisconsin Roots of the Modern Revolution in Structural Geology* and also includes a discussion of the work of Professor Gilbert Wilson of Wisconsin University and Imperial College.

A caseful of correspondence

My thanks are due to the Corresponding Fellows who have lived up to their name and I thank them for writing to me. I sincerely hope that they will forgive my jests at their expense! I also sincerely hope to contribute a second part to this article in the next issue, providing, of course, that my requests are not lost in the interim. If Fellows notice the inclusion of pink fluorescent paper and envelopes as a miscellaneous item in this year's accounts, they will know why!

List of current Correponding Fellows of the Society
(please note that I have not yet written to all of them!)

Prof. Ian W.D. Dalziel
University of Texas, USA

Prof. Dennis R. Dean
Evanston, Illinois, USA

Prof. Robert H. Dott Jr.
University of Wisconsin, USA

Ir. B.P. Hageman
Leiden, Netherlands

Prof. Gordon L. Herries Davies
Trinity College, Dublin

Dr. Radvan Horný
National Museum, Prague

Prof. Lester C. King
University of Natal, South Africa

Prof. A. Rittman
Institute de Vulcanologia della Universita, Catania, Sicily

Dr. H.H. Schmitt
Alburquerque, USA

Dr A.D. Stewart
Porchiano del Monte, Italy

Prof. Peter J. Wyllie
California Institute of Technology, Pasadena, USA

Dr Hatton S. Yoder Jr.
Washington DC, USA

Brick-a-brack

by Donald McIntyre

As readers will know, I am always glad to get feedback from articles published in this magazine. One such letter came from Donald McIntyre, who attempts to shed light on the brick symbol that is used to denote limestone on geological maps

Dear Alan

Thank you for another interesting issue of THE EDINBURGH GEOLOGIST. I was delighted to see Isles Strachan's article on *Maps and Legends*. We began geology together in the same class!

You ask why the 'brick' symbol was chosen to denote limestone and when this was first used. James Hutton's good friend John Clerk of Eldin used the symbol in many of his geological drawings. As a sample I enclose a photocopy of a portion of his drawing of the section exposed in an excavation of Frederick Street (probably in 1786/87) [printed opposite and on front cover].

I think that it was natural to use this symbol for well-bedded competent strata, not necessarily limestone, with prominent joints perpendicular to the bedding. John Clerk of Eldin's cross section of Salisbury Crags and Arthur's Seat uses the symbol for strata labelled 'Sand Stone' (see McIntyre & McKirdy, 1997, pp. 28-29).

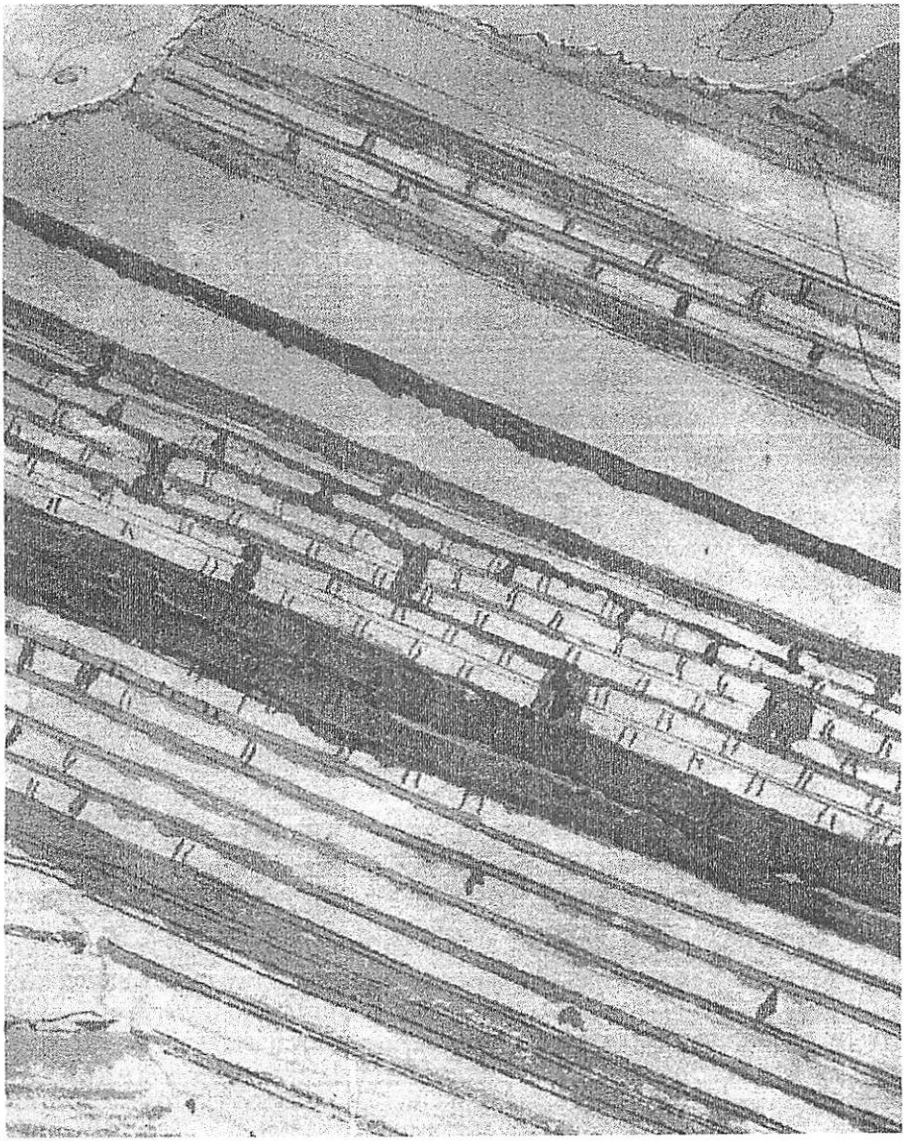
Unfortunately in retirement I no longer have ready access to older sources that may have used the symbol, but I have emphasised the modern aspect of Clerk of Eldin's sections (op. cit. pp. 23-24, 43-45).

Yours sincerely

Donald B. McIntyre

Donald's explanation is fair enough but, as he says, in these figures it was used to denote any well-bedded competent strata with prominent joints perpendicular to the bedding. Not wanting to flog a dead horse, but does anyone have further information on when it began to be used exclusively for limestone?

The book to which he refers is McIntyre & McKirdy, James Hutton: The Founder of Modern Geology, *published by the Staionery Office in 1997.*



A section exposed during the excavation of Princes Street in 1786-1787 showing the 'brick' symbol to depict well-bedded competent strata with prominent joints perpendicular to the bedding drawn by John Clerk of Eldin (from a photocopy of the original manuscript provided by Donald McIntyre)

What's in a Name?

In the absence of any contributions from Fellows, I have decided to follow up on a topic that is of particular interest to me!

Red Rocks

While I was in Hong Kong in the mid-nineties, I spent some time mapping the Devonian coastal section on Port Island in the eastern part of the Territory. As the little boat chugged towards its red cliffs (for the Devonian has a red facies even as far away as China), I had time to reflect on the name of the island. To the British colonials, it was the island at the head of the great natural harbour of Tolo Channel. To the Chinese it was simply *Chek Chau*, 'red island.' We have them in Scotland too, of course, for example *An Ruadh-eilean*, 'the red island', off the coast of Applecross, and *Sgeir Dearg*, 'red skerry', northeast of Scalpay off Skye. These are both Torridonian rather than Devonian, but I thought that it might be interesting to see how geology can be responsible for designation of place names. In this article, I shall be considering mainly red place names, though I shall take a ramble through blacks, greys, greens and blues as well.

There are actually two reds in Gaelic: *dearg*, a deep blood red with a hint of crimson*, and *ruadh*, more of a soft russet brown. It might be expected that the latter would crop up more often, but it is surprising how many *Càrn Deargs* there are around. It may be that the word is used to emphasize the difference between the red rocks of one mountain and the grey rocks of the surrounding area or neighbouring hills. Considering red rocks geologically, there are a lot of these in Scotland: the Torridonian, the Old Red Sandstone and the New Red Sandstone are the main sedimentary examples, but there are Caledonian granites and Cenozoic granites as well.

As regards the Torridonian, I have given the example of two red islands on either side of the Inner Sound, but it is interesting to look further north. Here we have Red Point north of Loch Torridon as well as mountains such as *Ruadh Stac Mòr*, 'big red stack' and *Beinn Dearg Mòr*, 'big red mountain', neighbouring hills in the Fisherfield Estate. But as well as the red facies of Stoer and Torridon groups, there

*note: I have taken many of the translations in this article from Peter Drummond's book *Scottish Hill and Mountain Names* published by the Scottish Mountaineering Trust. In order to make the piece readable, I have not attributed each occasion.

is the grey facies of the Sleat Group [Torridonian stratigraphers will no doubt tell me that it is not as simple as this. Okay, go on— tell me!]. Thus, further north, between Loch Ewe and Gruinard Bay, there is Greenstone Point. The Gaelic for this is *Rubha na Lice Uaine*, 'point of the green slabs', a reference to the drab flagstones. As well as *uaine*, which is generally a brighter green, the Gaels also have *glas*, which is more of a greenish grey. And there are several *Glas Eileans* scattered along the northwestern coast.

The Old Red Sandstone provides a similar colour range, though because of its distribution, Gaelic names are more difficult to come by. The cliff face at the northern end of Pease Bay, a locality well known to many of the Fellows of the Society, is known as Red Rock. But I am jumping ahead stratigraphically. The Lower Old Red Sandstone of Angus gives us place names such as Redcastle, on Lunan Bay, and Redford, 8 km inland from Arbroath. At the other end of the Midland Valley, the Old Red Sandstone is found on the coast of the Firth of Clyde, though Red Clydeside is so named for different reasons altogether.

The Middle Old Red Sandstone is restricted to Orkney and Caithness, which provides an interesting diversion, because in those regions, place names are almost entirely Norse. The Norse word for red is *raud*, while grey and green are *gra* and *graenn* respectively. Interestingly, however, the Vikings tended to name the parts of their landscape after people and animals rather than be influenced by the more poetic inspiration that stimulated the Gaels. Having said that, there is a Red Holm and both Muckle and Little Green Holms off the island of Eday. *Hölm* is a small island while muckle is an anglicisation of the Norse *mykill* meaning great.

The Upper Old Red Sandstone, with its bright orangish red colouring, should provide a wealth of place names, but with its outcrops scattered throughout the Midland Valley, it is rather difficult to tie down. I have mentioned Red Rock at the northern end of Pease Bay. At the southern end of the bay, the rocks are less oxidised, which gives the cliffs a more drab colour and the name of Greenheugh. Heugh is a 'rugged steep', possibly derived from the Old English *hoh*. In the main Borders outcrop of the Upper Old Red Sandstone, I have found Redpath Hill near Melrose, as well as the little hamlet of Sandystones, south of St. Boswells.

But if the Upper Old Red Sandstone proves difficult, the New Red Sandstone is just about hopeless. Part of the problem seems to be that the areas of its outcrop are agricultural land and an abundance of more modern names are found here. Mind you, up near Elgin I did find the farm of Rothills, though I feel that to suggest that this comes from the German *rot*, meaning red, is a little far-fetched!

What's in a Name?

And so to the granites. Again, in the Highlands, the Gaelic provides a wealth of place names. From the Cairngorm Massif (actually, *Cairn Gorm* means 'blue peak' but refers to the hazy blue colour that mountains afford from a distance), there are several *Càrn Dearg*s (Peter Drummond counts a dozen instances in upper Deeside alone), as well as a *Coire Ruadh* above Glen Feshie. From the Glencoe Complex, we have *Stob Dearg*, 'the red peak', the highest summit on *Buachaille Etive Mòr*, and from the Ben Nevis cauldron, *Càrn Mòr Dearg*, where the pink scree gives the mountain a distinctive colour. In some cases, the place names can suggest geological correlation as well. The Ross of Mull is lacking in red place names despite its being granitic, but 5 km to the south, the Torran Rocks include a *Dearg Sgeir* and a *Ruadh Sgeir*, both red skerries. Geophysical investigations have shown that the Ross of Mull granite extends southwards and encompasses these islands.

The Cenozoic igneous intrusions provide a poorer source of red place names, though this is largely because they tend to be basic in composition. On the island of Skye , we have the Cuillin, which probably from the Norse *kjolen*, meaning simply 'a high place'. But, more significantly for geologists, these mountains are divided into the Red Cuillin and the Black Cuillin. The former, all rounded hills, comprise granite, while the latter, more rugged, comprise gabbro and ultrabasic rocks. The names of individual peaks in these ranges reflect the colours as well, with more than one *Beinn Dearg Mhòr*, 'big red mountain' in the Red Cuillin and names such as *Sgurr Dubh Mhòr*, 'big black peak' in the Black Cuillin. Interestingly, the summit near which the Inaccessible Pinnacle stands (and it could be argued that it is geological forces that make it so inaccessible) is *Sgurr Dearg*, 'red peak'. I wonder whether this is possibly attributable to the red colour of weathered gabbro.

Further south, rhyolites and breccias on Mull give the name *Sgurr Dearg* to one of the prominent peaks on the island, but there is a paucity of red place names. Of course, there is a corresponding wealth of black ones: *Eilean Dubh*, Staffa, several *An Dubh-sgeir*s as well as *Clach Dhubh*, 'black rock' off Skye, *Dubh Artach*, 'black quarry', 25 km west of Colonsay and, still further offshore, Blackstones Bank itself. The lavas provide an interesting finale. The flat-lying nature of the stacked basalt flows provides place names such as MacLeod's Tables. These are individually named *Healaval Mhòr* and *Healaval Bheag*, which are the large and small tables respectively. *Healaval* itself probably comes from the Old Norse *hellyr* meaning 'flagstone.' But that is another story altogether.

As well as having worked on the Devonian red sandstones in Berwickshire and Hong Kong, your Editor is a member of the Scottish Place-Name Society and has an interest in toponymics... yes, that's what the subject is called!

Geo-vineyards

Tasting Notes

This is a more ancient vintage than the last couple of wines reviewed in these pages. The nose benefits from the extended periods of lagoonal and shallow marine incursion that prevailed on the southern sunny slopes of the Mercian Highlands during its fermentation. Its calciferous provenance makes it alkaline rather than acidic on the palate and it has strong overtones of carbon, giving it a rather smoky finish. The vintners say that it will last another couple of aeons, though personally I would suggest drinking now. Its maturity make it excellent with cheeses such as Lancashire Blue and Yoredale varieties such as Wensleydale.

Following the two labels that Cecilia Taylor sent to me for the last two issues of The Edinburgh Geologist, I managed to find this example while in northern Spain this Easter. But it is my last! Does anybody else have any similar bottles brought back from their holidays... I'll happily help with the tasting!

Poet's Corner

The Toad in the Stone
by Alexander Rose

This 'geological chaunt' was sung by the Author at the Anniversary of the Edinburgh Geological Society, to the tune "Woo'd an' married an' a' ". It appears in Mrs Rose's biography and was sent to me by David Land.

Chorus: *O, I am a merry old Toad,*
Though a lonely old Toad am I;
It is long since I hobbled abroad,
To gaze on the clear blue sky.

I've a wonderful story to tell,
Gin folk wad but listen to me;
Though I speak from my horrible cell,
That ance lay at the grund o' the sea.
I'm noo on the bree o' the hill,
For my house has been drifted about,
By the winds and the waves at their will
Yet I never could find my way out.
O, I am a merry old Toad, etc.

Ben Nevis it ance was my hame,
Though noo I'm on Berwick Law tap;
I hae rambled thro' flood and thro' flame,
Without ony serious mishap.
Two thousand land years and mair
Hae baith seen the bloom an' the bud
Sin' I was shut in frae the air,
In my smug little dungeon o' mud.
O, I am a merry old Toad, etc.

I hae feasted on little sin' then,
An' I'm ready to gie my aith
Before ony body o' men,
That I've scarcely e'en drawn my breath.
The very last meal that I gobbled
Was a worm an inch in length
Yet Nature my frame has sae cobbled
That I never hae failed in my strength.
O, I am a merry old Toad, etc.

'Tis true that I'm fond o' the dark
Yet I sigh for the light o' the day;
An' the mellow toned notes o' the lark,
When it sings in the morn's first ray.
Yet I think I hae 'scaped mony ills
Sin' I cam to this honeyless hive
For here there's naething that kills,
If there's naething to keep me alive.
O, I am a merry old Toad, etc.

Some chiel wi' a big knappin' hammer,
Ae day ga'e my stane sic a fell,
That I raised sic a horrible clamour,
He e'en thought it was Sawney himsel';
He fled— but the hammer he drappit,
With whilk he was breakin' my stane;
Syne my stane I row'd on the tap o't—
An' noo it's a fossil remain.
O, I am a merry old Toad, etc.

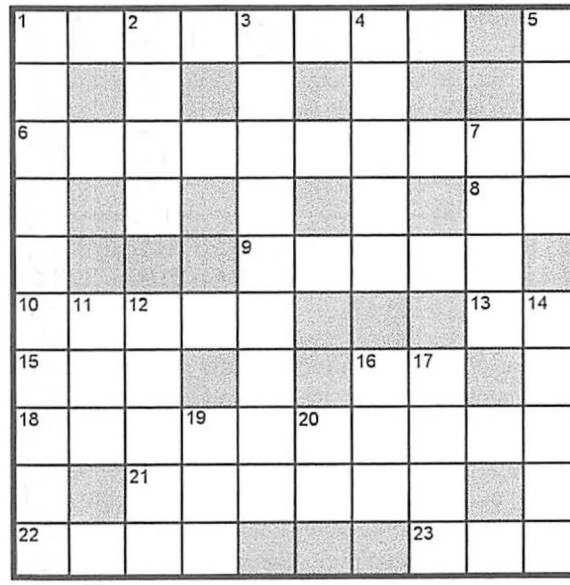
Poet's Corner

The hills and the howes hae aft flitted,
Like toads on the breast o' a pool,
Sin' round me my prison was fitted,
Without ony compass or rule.
Terodactyles an' big reptile Fishes,
I've seen in their glory an' prime,
Wha aft on my frien's made sic dishes,
As perished a tribe at a time.
O, I am a merry old Toad, etc.

Great mammoths wi' bodies prodigious,
I've seen on the face o' the yirth,
And Krakins sae fearfu' an' hideous,
That shook the hale warld in their mirth.
Aligators wi' teeth like a whittle,
An' tails that could wallop the moon,
Wi' skins like the hardest o' metal,
To hap their big bodies a'roun'.
O, I am a merry old Toad, etc.

Mony things I hae seen unrelated,
Lang syne when I wandered abroad,
An' a story may not be inflated,
Though it's told by a hard livin' toad.
An' those who are anxious to hear them—
Strange things o' the times that are gane,
May come when they've time, an' just speer them,
An' lay their lugs close to my stane.
O, I am a merry old Toad, etc.

Rocksword Puzzle No. 6



compiled by Angela Anderson

Clues across

1. Swain lie on oldest British rocks (8 letters)
6. Crime Colin hatched crossly on K-spar (10)
8. Small island in wishing well (2)
9. see 4 down
10. Back all at reservoir north of Moffat (5)
13. Leave having any less agony (2)
15. In so vast an egg (3)
16. Genitive preposition in crofting (2)
18. Evening tin makes fine intrusions (3-7)
21. Island found in ideas terrestrial (6)
22. Winnows or tosses or keeps in order (4)
23. A long time in neon lights (3)

Clues down

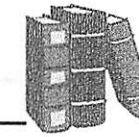
1. Notes smile on the calciferous (10)
2. Town in Caithness - a centre for candle-making ?(4)
3. Move Cassio (not I) in 1 down near Durness (4,5)

4, 9 across. I scair a lag off Ayrshire coast (5,5)

5. Golfers assistants set out in East (4)
7. Black Isle oil rig bay (4)
11. Maria's short avenue? (3)
12. Out East relate round in time (5)
14. Groan around a body part (5)
16. Singularly single (3)
17. The light rife around opal (4)
19. A tax on a large vessel (3)
20. Diminutive Italian entombed in granite (2)

This is Angela's sixth puzzle, for which you will need sharpen your wits as well as your pencils. The answers (for those who are completely stumped) are on page 44.

BOOK REVIEWS



Three books are reviewed in this issue, including no less than two on William Smith, the 'father of English Geology'. Andrew McMillan and Norman Butcher have looked at these and there is enough material in the two reviews to fuel a mini article on Smith! The third book is slightly different, the story of a love affair with a small part of England. I note that Tempus *has also published a book entitled* Scotland's Hidden History. *It would be interesting to have a glimpse of that too.*

STRATA - HOW WILLIAM SMITH DREW THE FIRST MAP OF THE EARTH IN 1801 AND INSPIRED THE SCIENCE OF GEOLOGY

Andrew McMillan

When, exactly two hundred years ago, William Smith (1769-1839) circulated his first geological map of England and Wales with accompanying prospectus, he might have expected accolades from all quarters. Instead, apart from encouragement from his friends and benefactors, little attention was paid to this outstanding achievement. Despite its obvious benefit for a wide range of applications and its provision of scientific proof for uniformitarianism, it took some years for the awakening geological fraternity to realise its value. By 1807, members of the newly-founded Geological Society of London, recognising the usefulness of such an enterprise, embarked on their own geological map of England. Utilising the advice of John Farey (Farey was a friend of Smith and received tuition in geological mapping from him), the Geological Society of London enterprise under the direction of its President, G.B. Greenough, marched on apace. Smith was largely bypassed, much to his disgust. Although the magnificent hand-painted edition entitled *The delineation of strata of England and Wales* was published by Smith in 1815 its sales dropped after the Greenough map appeared in 1819.

We learn about this saga in John Morton's illustrated book *Strata*. Rather extravagantly subtitled (the science of geology was undoubtedly inspired in the late eighteenth century by several enlightened people including, not least, James Hutton), the book chronicles Smith's journey through geological time and Anglian space. It describes his humble background and his early work on the Somerset Coal Canal. Here he learnt so much about the stratigraphy and the value of fossils and lithology. It shows how his later years spent as a drainage engineer enabled him to apply his observations and knowledge to map out the strata. Indeed he was in such demand for his practical skills so necessary to earn a living, that he seldom had sufficient time to devote to writing up his discoveries - *plus ça change*. This,

combined with his non-gentrified approach to life did not endear him to the establishment. In particular, the embryonic Geological Society of London never invited him into its fold as a Fellow. It also left his intellectual property vulnerable to exploitation by others. However, recognition eventually followed. Towards the end of his life, in 1831, Smith became the first recipient of the Wollaston Medal of the Geological Society of London. Its President, Professor Adam Sedgwick, acclaimed him as 'the father of English Geology'. The Government was successfully petitioned to award him a pension. In modern times his name is revered and the William Smith Medal for excellence in Engineering Geology, instituted by the Geological Society in 1977, is one of its most prestigious awards.

This book makes much use of the published accounts of Smith's work, his own letters and those of his contemporaries. The author places much reliance on this first hand source of data and anecdote and chooses to let much of the material speak for itself. However excessive quotation from letters and contemporary accounts makes for a difficult read. Furthermore, there seems to be little acknowledgement in the text of the sources of manuscript materials; frustrating for someone wishing to delve deeper. The book details not only the great man's insight into the order and distribution of the rocks of England, Wales and the south of Scotland but also his perception of the value to the nation of such knowledge. But the reader is left with the impression that there is something missing. Advertised in the Acknowledgements as the only full biography of Smith, with the exception of the memoirs of John Phillips (Smith's nephew), the book accentuates the picture of a man, barely tolerated or ignored by establishment figures and embittered by plagiarism, intended or otherwise, by his contemporaries. Perhaps there is nothing more from the archives to report but it would have been good to know something more of his private as opposed to professional life. For instance there are but two mentions of Mary Ann, his 'mad, bad wife' (*sic.*, John Phillips). It seems there is little record of his life with her or with his siblings (of whom there were four). Was he so constantly on the move answering the practical enquiries of landowners, canal engineers, mine managers and land improvers that he could never set down roots? Did he think stratigraphy all the time? Perhaps there are no answers.

Late in his life, Smith was offered many positions one of which was a member of the commission set up in 1838 (only a year before his death) to select building stone for the Palace of Westminster. We read that 'Dr. Smith's contribution to the commission had been most valuable'. No doubt his knowledge of stone sources was second to none. Unfortunately, recommended sources of Magnesian Limestone at Mansfield and Bolsover proved to have inadequate resources and a third quarry at

Anston was substituted. However the acidic city atmosphere had a devastating weathering effect on the stone and it is probably one of the most notorious examples of the use of inappropriate natural building stone!

This book makes accessible a wealth of information about a great practitioner, a practical man who had the insight to lay down the principles of stratigraphy and explain their value. Illustrations (some a little fuzzy, e.g. figures 24 and 28) of notable places and buildings associated with Smith, his writings, fossils, sections and maps serve as tangible reminders of one of geological science's finest exponents largely unknown to the public. *Strata* together with Simon Winchester's much heralded volume, will go some way to putting Smith on the map.

STRATA - HOW WILLIAM SMITH DREW THE FIRST MAP OF THE EARTH IN 1801 AND INSPIRED THE SCIENCE OF GEOLOGY
John L. Morton
Tempus Publishing Ltd., £9.99
ISBN 0 7524 1992 7 (paperback)

Andrew McMillan is an active Fellow of the Society. He has been a member of the British Geological Survey for over 25 years and has spent time in Minerals Assessment as well as mapping in the Midland Valley and Southern Uplands.

THE MAP THAT CHANGED THE WORLD **Norman Butcher**

I first became aware of this best-selling author's latest book on William Smith and his great geological map *A Delineation of the Strata of England and Wales with part of Scotland 1815*, from a pre-publication review I chanced upon in *The Scotsman* on Monday 2nd July. With Winchester's own piece in *The Times*, also that day (illustrated by a very poor reproduction in colour of the map), further newspaper reviews that week and with Melvyn Bragg hosting a ¾ hour discussion on Radio 4 on the history of geology on the day of publication, Thursday 5th July, not to mention the big launch at the University Museum in Oxford and the book being selected as Book of the Week read every day on Radio 4 the following week, it became clear that a massive publicity machine was in full swing.

This is all very good for Simon Winchester, the publishers and untold booksellers of course, but what about William Smith? There is no doubt that his is an intriguing story, not, sadly, previously told except through the medium of Hugh Torrens's wonderful lectures on Smith. Simon Winchester applies his literary and journalistic skills to William Smith in the style of his best selling book *The*

Surgeon of Crowthorne, about the making of the Oxford English Dictionary. I find it very interesting that, in so doing, Winchester completely misses the essential point about William Smith and his work, which is that, poor as Smith's own writing skills undoubtedly were, he, William Smith, Mineral Surveyor, nevertheless laid the foundations of the visual language of our science. Smith's maps are the best possible demonstration of what F.J. North called 'the dynamic force in geology'.

Throughout the late 1950s and 1960s, I began my first lecture of my first year course to Science, Agriculture and Arts students at the University of Reading by showing them Smith's great map and reading the title on sheet III. In 1967, I mounted a three-month long major exhibition on the history and development of geological cartography in the University Library in Reading. Smith's own maps were a key feature. Victor and Joan Eyles told me that they bought their first copy of Smith's large map in 1933 for 3/6d. It has for some time now been amongst the most highly valued items in the history of geology. Moreover, the Eyleses had a complete set, in their original blue wrappers, of Smith's County Maps. R.V. Tooley, Editor of the Map Collectors' Circle, told me that the reason that copies of Smith's County Maps were so rare was that booksellers used them for wrapping up parcels of books.

Unfortunately, Winchester's book has a dreadful dust jacket but both the 25-mile geological map of the British Islands and Smith's great map are printed in colour quite well inside both front and back covers, despite considerable reduction. The book is delightfully illustrated, especially by the beautiful drawings of ammonites that adorn, in stratigraphical order, each chapter heading, except for chapter 11 *A Jurassic interlude*, where Winchester's own early upbringing and introduction to geology is intruded with a thin section of an oölite.

For those members of the public who may not have heard of William Smith and his remarkable achievements, or even geology at all, this book should make an interesting read. Unfortunately, or perhaps fortunately, the history of geology is far more complex and subtle than Simon Winchester makes out. For instance, Greenough's map of 1819, drawn in fact by Thomas Webster, shows Webster's own work in respect of the Isle of Wight, which was published in 1816 and which was way ahead of Smith's own knowledge of the island at that time.

With a somewhat odd concluding chapter on *Sources and recommended reading*, the final *Acknowledgements* makes especially interesting reading. Winchester is surely right to say that Victor and Joan Eyles should have written the book. But

with another book on Smith also now published (see the review by Andrew McMillan, this issue), where does this leave Hugh Torrens's retirement project? Simon Winchester is fulsome in praise of Hugh Torrens, but is this book simply the *hors d'oeuvre* that he maintains it is? Rumour has it that this book is to be turned into a film in the manner of Dava Sobel's *Longitude*. I do hope that I am asked to play the part of William Smith.

THE MAP THAT CHANGED THE WORLD
Simon Winchester
Viking Press, £12.99
ISBN 0 670 88407 3 (hardback)

Norman Butcher is well known to Fellows of the Society. He is an acknowledged expert in the history of geological maps, so it is hardly surprising that he bought this book, as well as John Morton's Strata, *and we are delighted that he offered to review it for* THE EDINBURGH GEOLOGIST.

NORTHUMBERLAND: THE POWER OF PLACE **David Land**

I can heartily recommend this book on Northumberland to anyone, whether anglophobe or anglophile, who is interested in the county. It is not a guide, either historical or topographical, but it sets out to convey the essence of the county by exploring a limited number of places which, for the author, evoke what he calls 'power of place'. This is a concept that any locality, by virtue of its unique geology, natural and human history, together with less tangible attributes such as landscape beauty and poetical or visual inspiration, when its attributes are considered as a combined whole, generates powerful feelings of empathy and appreciation: the power of place. Of course it has long been recognised, usually implicitly rather than explicitly, that every locality has unique attributes, but these have generally been considered separately rather than, as here, as an integrated whole.

The author is an archaeologist, teacher, lecturer and dramatist who has lived in Northumberland since 1966 and clearly loves his adoptive county. His archaeological studies lead directly to geology, landscape and natural history, and thence to human history. Less tangible aspects are expressed in poems and abstract paintings. These may or may not appeal to the reader, but they do help to evoke the power of place. The author's choice of places to be described is rather arbitrary, depending on which appeal to him, particularly those where he has studied their archaeology.

Over half of the book is devoted to only seven locations, but these are discussed in depth in order to bring out their full character and power. These locations are Old

Bewick (chapter 1), Ford and Etal (chapter 4), Hexham (chapter 5), Edlingham (chapter 7), Breamish and Glendale (chapter 9). Chapter 2 comprises a brief excursion into place names.

Border history inevitably dominates the county, and in chapter 3, *War and peace: the Border*, there is a wide ranging discussion that is quite fair to both sides. The author is very taken with Border ballads, wishing that they could be better known and appreciated. The second half of the chapter is devoted to the defensive towers that are such a notable feature of Border landscape. Chapter 6, headed *Townscapes* gives brief appreciations of Warkworth, Alnwick, Berwick-upon-Tweed, Newbiggin and Morpeth, with a digression from towns to the coast from Lindisfarne to Woodhorn. Chapter 8 on Lord Armstrong of Cragside is largely a biography of the armaments manufacturer, together with a description of his house *Cragside* at Rothbury.

If I have a quibble with this book, it is with the maps. Figure 7, Old Bewick, drawn by Paul Brown, and figures 27 and 28, Acklington tithe map and the lower Coquet, both by Richard Parkin, are excellently drawn. Unattributed figures 1 (place names), 81 (Warden), 126 (Ingram) and 134 (Akeld-Kirknewton) are just about adequate though very inelegantly drawn. But figure 125 (geological map of Northumberland) is a small horror, coarse and quite useless to serve its purpose of relating places to their geological setting. If neatly drawn on a larger scale and placed earlier in the book, it could have been a useful map. Despite these reservations, I can thoroughly recommend this lavishly-illustrated book, which is well-written, knowledgeable, interesting and full of enthusiasm for Northumberland.

NORTHUMBERLAND: THE POWER OF PLACE
Stan Beckensall
Tempus Publishing Ltd., £14.99
ISBN 0 7524 1907 2 (paperback)

David Land, a one-time member of the BGS Newcastle Office, received a copy of the book when he was Sales Secretary of the Society. He was so impressed with it that he offered to write a review for The Edinburgh Geologist. *The copy of the book is now in the Society's Library Collection.*

Rocksword Puzzle No. 6

Solution to puzzle on page 37

Clues across

1. LEWISIAN
6. MICROCLINE
8. IS
9. CRAIG
10. TALLA
13. GO
15. OVA
16. OF
18. NET-VEINING
21. EASTER
22. SORT
23. EON

Clues down

1. LIMESTONES
2. WICK
3. SMOO CAVES
4 AILSA
5. TEES
7. NIGG
11. AVE
12. LATER
14. ORGAN
16. ONE
17. FIRE
19. VAT
20. IT

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