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The North West Geologist

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THE NORTH WEST GEOLOGIST
(Formerly THE AMATEUR GEOLOGIST)

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Editorial

This editorial must begin on a sad note in reporting the recent death of two former Presidents of the MGA. James (Jim) McCurdy died on 29 August 1996 aged 72, and Bill Peacock, elder statesman of the Association, and also a former Editor of this journal, died on 11 February 1997, aged 94. Both men gave many years of valued service to the MGA and will be sadly missed. We are grateful to Derek Brumhead and Don Taylor for writing the obituaries published in this volume.

On a happier note the MGA and LGS are delighted to welcome the Lancashire Geologists' Association into our fold. From this edition onwards *The North West Geologist* will be the official journal of all three groups and we hope you will agree that it is most appropriate that the three foremost geological gatherings in the north-west should liaise in this way. We look forward to a fruitful association and your editors look forward with relish to the additional copy that will no doubt result ! Please keep the contributions coming in - serious papers, shorter articles, book reviews, field trip reports, letters, cartoons etc. - we will consider them all !

John R Nudds (MGA) N.C. Hunt (LGS) Alistair Bowden (LGA)
Spring 1997

Notes for Authors

Articles and suggestions for future issues are always most welcome and should be sent to either Dr John R Nudds, The Manchester Museum, The University of Manchester, Oxford Road, Manchester M13 9PL, N.C. Hunt, Department of Earth Sciences, The University, Liverpool L69 2HX, or Alistair Bowden, Clitheroe Castle Museum, Castle Hill, Clitheroe, BB7 1BA. Articles should preferably be presented on disk, if possible in **Wordperfect** (Windows or DOS), and may be up to 3,000 words in length. Figures should be designed for reduction to fit a maximum frame size of 180mm x 125mm.

Back numbers of *The Amateur Geologist* and *The North West Geologist*

Limited stocks of most previous issues are held in Manchester and Liverpool and copies can be obtained by application to the editors.

IN BRIEF....

Lottery win for The Manchester Museum

In the last issue we reported on the Heritage Lottery Fund award of £6 million to the former Geological Museum in South Kensington, now the *Earth Galleries* of The Natural History Museum. Not to be outdone, The Manchester Museum announced in February that it has been offered £12 million from the Lottery on the condition that it can itself raise sufficient partnership funding. Ambitious plans include a restaurant, a refurbished shop, a new entrance and improved access, new temporary exhibition galleries, a "Discovery" Centre, new stores and offices AND a completely re-displayed geological gallery. Unfortunately the present Mineral Gallery will be lost, as will many of the traditional displays in the Stratigraphic Gallery. We hope that whatever replaces them will be of the same academic quality as those that have inspired students for many years.

BGS stays in Public Sector

The Government has announced that following the recent *Prior Options Review* it has concluded that the British Geological Survey should remain in the public sector. The Prior Options study of the organization was undertaken to look at four possible scenarios, viz. abolition, privatisation, contractorisation and rationalisation. The conclusion reached reflects an appreciation of the importance of BGS science and is certainly good news for the academic sector.

A new Lagerstatte in Lancashire

Many readers will be aware of the exceptionally preserved Upper Carboniferous arthropods (and other organisms) from the Westphalian of Sparth Bottoms, in Rochdale, collected and described mainly by William Parker in the early years of the century and which formed the topic of a paper by Andrew Tenny in the previous edition of this journal (*The North West Geologist* 6, 10-17). That site is now filled in and landscaped as part of Rochdale's Mandale Park, but in the last few years the Arthropod Palaeobiology Research Group, based in Manchester University's Department of Earth Sciences, have discovered a new lagerstatte, most probably at the same horizon as Sparth, at several localities in Lancashire. The first and most important of these sites is at Bickershaw, near Leigh, where several hundreds of specimens have been recovered from nodules in the Westphalian A shales. The fauna and flora form the subject of a paper shortly to appear in the *Geological Journal* by Lyall Anderson, Carl Horrocks (who initially discovered the site), Jason Dunlop and Heather Winkelman. Michael Eagar is to contribute a section on the non-

marine bivalves, which should tie down the stratigraphic horizon precisely. This exciting find includes xiphosurans, spiders, scorpions, shrimps, millipedes, fish, coprolites, plants and bivalves. The collections have been deposited in The Manchester Museum.

The K/T extinction explained - or not ?

Press reports early in February suggested that new geochemical evidence, from deep sea sediments recovered during the latest JOIDES project, gave weight to the theory that the extinction of the dinosaurs at the end of the Cretaceous was indeed due to a massive meteor impact. However, at the end of March a team of over 20 scientists from the Natural History Museum and University College London, contested this theory and reported that a more likely cause for the Cretaceous extinctions was a dramatic fall in sea level of around 100m, coupled with excessive volcanic activity at this time; both factors causing gradual climatic change. This is more consistent with the gradual extinction of many groups during the Cretaceous as seen in the fossil record. The controversy continues.

(John R. Nudds)

LETTERS TO THE EDITOR

Dear Editor, *5.11.96*

Thanks to the Manchester Geological Association I was fortunate to be included in the organised trip to Iceland led by Chris Hunt (of Liverpool University) in his jeep.

There were eleven of us transported by mini-bus and behind that came John Hakes and his family in their Range Rover. They were kind enough to carry a lot of our gear for us all.

We travelled, walked and camped in cold or temperate climes, gales or calm, to view most of the renown sites and many lesser known areas of geological interest - due to their inaccessibility - for which we thank Chris's knowledge of "off" tracks or obscure "roads" to these places.

Wherever you looked across vast unpopulated expanses of seeming tranquillity you were aware of the latent power awaiting its own specific release – as one could observe, with equanimity, at the geyser Strokkur.

Throughout the visit there were sills, dykes, fault scarps, incredible waterfalls pounding a course through ravines, pungent hot springs and their own sulphurous beauty, pseudo-craters, cinder cones, volcanic mountains of differing types, witches paradises of lava fields and lakes and even the disillusionment that the magnificent ice-caps have dirty fringes ! To walk by the 160m deep glacial lagoon of Jokulsaion and view the exquisite icebergs and their reflections in perfect symmetry before strolling to watch the outflow rage out to the sea past the beach where nesting terns and skuas swooped to attack us.

In all the amazing geological interest there were plenty of birds and plants to view as well.

We camped at Skaftafell for two nights - even walking briefly on the Vatnajokull glacier at Svinafells, and longer, next day, along its edge.

We left on July 30th '96, driving over the new 0.9km bridge and across the immense braided terrain and its highway for about an hour enquiring what it would be like for an eruption through the ice-cap. Imagine our consternation when on October 5th news of the volcanic eruption in the north of that very ice-cap, preceded, what we now know of the more recent destruction of that whole area in November with tremendous flooding.

We have stayed there, travelled and marvelled. For those who have seen greater geological wonders are fortunate indeed. I only know it is a very special place to visit and am grateful."

P. Adair Williams

Dear Editor, 9.9.96

"I was pleased recently to receive this publication [*The North West Geologist* 6] from Tony Browne and read two articles relating to the Bollin Valley with interest if not total comprehension, as I am not a geologist myself.

I have since spoken to Tony and would like to put on record two points: one fact and one comment. [These refer to the article by Grayson *et al.*, "The creation of the Bollin Ox-bows near Manchester Airport and collapse breccia of Cheshire Salt" - Editor]

Firstly, could I point out that the Bollin Valley Way does not follow the Bollin from Wilmslow downstream to the Airport runway (see p. 24 "By following the Bollin Valley Way...bottom to top." and p. 26 "Horizons very low...described by Thompson.") The majority of the path from Twinnies to Wilmslow Moat House is within the ambit of the National Trust at Styal Country Park. The Trust were not keen for the B.V. Way to traverse their land, so instead it takes walkers up Piggenshaw Brook and across the fields near Morley Green.

My second concern is with the statement (p. 42) that the geomorphological interest of the Bollin is "more insidiously, under threat at many points between here and Mottram Bridge from overzealous defence of inappropriately positioned segments of the

Bollin Way ...from misguided treeplanting and the inappropriate excavation of ponds for wildlife." This seems to be an implicit condemnation of the management practices of the Bollin Valley Project, although I may be being unduly sensitive and reading into it something which was either not intended or directed at someone else !

It should be understood that the B.V. Way was not created from nothing, but merely follows some of the 100 plus miles of public right of way along the river corridor which we manage. We have a duty to maintain those paths in a walkable condition wherever possible. Very occasionally we undertake bank revetment work but have never done so along this stretch of the River. More often, as in the case of the footpath south of the Moat House towards Hookshank Wood, we have to admit defeat by the forces of nature and initiate the lengthy process of applying for a footpath diversion.

As far as tree planting and pond excavation are concerned, our pleas is similarly "Not guilty".

We are countryside managers, with a collective range of experience and expertise which, sadly, does not include geology. So we welcome dialogue with and advice from experts to help us to conserve and enhance all the many valued an interwoven characteristics of this area to which we devote our working lives."

Yours sincerely,

Mrs Andy Collins
Visitor Services Officer

OBITUARIES

James Clifford McCurdy (6 August 1924 - 29 August 1996)

Though our paths crossed in 1945, he a College Apprentice, I a Trade Apprentice, both starting work at Metropolitan Vickers, Trafford Park, Manchester (where Jim was to spend all his working life), it was 1953 before I got to know him. He was employed in Steam Turbine Design Engineers, when after leaving the Royal Navy I started work in the Steam Turbine Drawing Office.

During these formative years, 1953-60, I got to know him, he as an engineer, I as a draughtsman. I soon realised the thoroughness of the man, thrashing out problems to the smallest detail and wanting input from both sides. This set up a liking for each other and, being able to have at times some very heated arguments without animosity, a respect grew between us, a foundation of a friendship lasting 43 years.

I was transferred to the Design Department in 1960 working under Jim for a few years, which, even if I say it myself, became an excellent team, Jim the intellectual, I the practical member. During this time I learnt a great deal from him and about him. Even after leaving the section he helped me with problems.

1971 was the year that changed my life completely when I was declared redundant. It was then that I realised what a friend I had. He helped me before and after leaving the firm. By chance I became a painter and decorator and his friendship shared yet again, by him taking a chance and giving me work in his home, then liking the work recommended me to others. Knowing how exacting he was gave me confidence to turn my amateur skill into a professional one, and so becoming self-employed.

Above is an outline of how we became friends and his help over the years, but there was much more to Jim than that, which I was privileged to be part of. His exactness, which at times could drive one mad, the many arguments over a large range of subjects, football, World War II, the environment etc. Then the discussions about places, their geology and archaeology, music, theatre, his garden which he loved. He was a very interesting person to talk with. We were still arguing up to three weeks before he died. He was also a compulsive note-taker, which he would use to prove a point. I can still hear him saying to me, "Write it down, you always forget

something !".

He was a very private, considerate and kind person, who helped a great number of people out of difficulties. His kindness and sense of humour are illustrated in two events that happened a few years ago. Talking with my daughter, then aged 10 or 12, in his garden, he learnt that she was interested in ornithology. The next time that they met he presented her with a good quality bird book which she still has in her home in Switzerland nearly 30 years later. The other example was when I first worked in his home. After two days he inquired why I had not made myself a drink. I replied that it had not been offered. The following day, laid out on the kitchen table was a large array of beverages, 12 or more, with a note stuck on top reading, "DON, TAKE YOUR PICK. JIM".

This obituary is just a small insight into the personal life of one who was to me a very special man. I had complete trust in him, which in turn he extended back to me, especially in the last few months of his life.

In two words - *A friend.*

(Don Taylor)

Jim McCurdy (1924 - 1996)

Jim died on 29 August 1996 aged 72. Like many informed amateurs who have always graced our subject, he was highly qualified in a career which had little connection with geology. Jim was a mechanical design engineer on large steam turbines and worked all his life for Metropolitan-Vickers which eventually became part of G.E.C.

He was a member of the Association for nearly thirty years and was a regular attender not only at our meetings and field excursions, but also at other meetings held by our sister society at Liverpool and other societies. His wide interests also brought him membership of the Manchester Literary and Philosophical Society. As secretary of the MGA I often had dealings and much correspondence with Jim, enshrined in the Association's archive files, and now preserved in the Geology Department of The Manchester Museum. Jim was a stickler for detail, particularly pursuing matters of fact or procedure, always writing in an immaculate round hand on distinctive lined paper which looked as if it had been rescued from some surplus was department supply. His commitment to the aims of the Association was extended into being a very

efficient Excursion Secretary from 1978-81. In 1986-87, the then Excursion Secretary was taken ill suddenly and could not carry out his duties. It says much for the respect we held of Jim that I immediately approached him and asked if he could step in. Within two months, a sheet arrived with all the coming season's excursions, dates and leaders arranged. This was typical of his attention to any task at hand.

He was very proud to be President in 1988-89, a position for which he was eminently qualified. Unfortunately his health precluded him from serving a second year. He was also a member of Council from 1987-93. While serving on Council his insistence on detail, often on minor matters, although sometimes irritating invariably carried a grain of logic. It certainly kept one up to the mark ! Fudge was not a word in Jim's vocabulary. Shortly before he became really ill, there was a typical dispute over whether in the title, "Indoor Meetings Secretary", the word "meetings" should carry a "s" or not !

One often regularly remembers past friends and colleagues through some mundane matter of everyday life. In my case with Jim it is every morning when I take a shower ! I was with him on a superb residential field excursion to north west Scotland with the Liverpool society, when the hotel's *en-suite* facilities failed to come up to his requirements. "A shower, but no bath", he complained to me. "How is one expected to wash one's feet!".

(Derek Brumhead)

Bill Peacock (December 1902 - 11 February 1997)

Bill Peacock, who died on 11 February 1997 aged 94, was a member of the MGA for over thirty years and made an outstanding contribution to its affairs, becoming one of its most respected members. He served on Council from 1967 to 1989, was President in 1974-76, and an editor of *The Amateur Geologist* from 1975-89. Right up to his last illness, he was a regular attender at meetings where he often made pertinent comments and questions based on his extensive knowledge of the subject and travels in this country and in Europe. Bill was a man of the most outstanding variety of interests and expertise, and this is brought out by affectionate contributions below.

His son Tom and daughter-in-law Muriel have kindly contributed the following about Bill's personal life:

Bill was born in December 1902 in Swinton and with his sisters Kitty and

Susan attended Halton Bank School. In his late teens he left Swinton and was employed as a farm hand on his cousin's farm, Holmescales Farm, in Kendal. After several years he decided to go to Australia and New Zealand, seeing and touring those countries and "worked his passage" mainly by working on the railways. In 1931 he came home and became a C.I.S. insurance agent, working in the Eccles and Barton area. It was through his insurance agency that he met Eleanor Woods, whom he married in 1934. She died in 1978. They had three sons, Richard, Thomas and the late James.

During his life he enjoyed all the natural beauty, animals and birds, and also enjoyed climbing mountains. After his retirement in 1966, he toured most European countries with a life-long friend, Fred Overton. He became a very keen student of the French language at the Old Green Lane College and he held "French Circles" at his home. Bill's love of music led him to be a founder member of the Irlcadians Male Voice Choir, now the Irlam Male Voice Choir. He was a founder member of the Irlam and Cadishead Operatic Society, and sang many times at Wesleyan churches in performances of the Messiah, Elijah and Haydn's Creation. He was President until his death of the male voice choir.

He was also a member and worshipful Master of Derby Lodge 1066. During his retirement he became a founder member of the Irlam Probus Club and he also enjoyed the social events of the Irlam Rotary Club.

Bill was always interested in the formation of rocks and mountains and gave many talks on the subject of geology. He did a lot of fieldwork with his friend, Dr Michael Eagar. He loved to walk on Penmaenmawr beach, picking up coloured and interesting pebbles and giving Tom and Muriel "hands-on" lectures.

Before, during and after the 1939-45 war, Bill was a keen bee-keeper and with his friend "Paddy", enjoyed keeping them and the honey as a food as well as for its medicinal value. [He regularly brought his bees out to Birch Vale near New Mills, to feats on the heather.] Naturally, he enjoyed his garden, growing vegetables and flowers for all his family, friends and neighbours. He was a proud grandfather to his seven grandchildren, and great-grandfather to one, enjoying to the full all the family events.

Dr Michael Eagar, formerly Keeper of Geology at The Manchester Museum, with whom Bill worked for many years, has kindly contributed the

following appreciation:

Bill was a very good friend of both Enid and myself and he was especially patient with my inability to hear. He helped me in some of my later research field trips, and typically undertook the heavy labour of clearing sections with great energy and thoroughness. He was very good to be with, quietly enthusiastic and always interested, and willing to be taken anywhere when we were exploring.

Bill was a unique, splendid person, who enjoyed geology, above all geology in the field, and travel. As a companion on a field trip, especially one involving large-scale collection, he was magnificent, often wielding a heavy-spade seemingly as easily as a hammer, and with a persistent energy which I, a number of years his junior, could hardly keep pace with. He was a fine companion. I have happy memories of a three-day trip when he took me to Scotland in his dormobile, and of waking up to the smell of ham and frying eggs, far out of Edinburgh on the verges of a coal opencast.

One excursion together is particularly memorable. We explored Burrs, a strange piece of isolated country in the midst of heavily populated Bury. Here we were confronted by the River Irwell - and a highly desirable geological section on the wrong side of the river ! Bill, on the next trip with me, produced an inflatable rubber dinghy and together we paddled it, holed it, and very nearly sank in it. But we reached the section, worked it, and later pulled the heavy, flabby dinghy carcase up a nearly vertical face, filled with geological treasure. We both particularly enjoyed the much later MGA excursion to Burrs where, in character with the place it rained quite a bit. We were reminded of Stanley Holloway's classic monologue *Three Ha'pence a foot* when

> It rained and it still kept on raining,
> 'til th' Irwell were fifty miles wide.
> The 'ouses were soon under water
> And folks to the roof had to climb.
> They said it were the rottenest summer
> That Bury had had for some time.

Bill made several long trips to France, again with his dormobile. Others of the Association may well know more of these trips than I do. I merely saw some of the spoils on more than one occasion. As a result, he gave me several fine specimens for the Museum's collections. He had

a French geologist as a co-worker some of the time. Their itineraries varied widely and included trips to the Dordogne. At home, he particularly loved Anglesey and its superb sections and beaches.

Enid and I continued to see him after his more active geological collecting trips were over, and later when the condition of his eyes made driving impossible, although he recently made an excellent recovery. We wrote to one another, usually on geological topics. In the summer of 1994, we had the opportunity of taking him to Muker, a lovely unchanged village in Swaledale. There in the churchyard he found records of his ancestors, who were farmers. Bill recorded his own visit in the church, so that I learnt there for the first time that he was a good deal older than we thought.

Bill was a keen Freemason with a distinguished record as holder of high office. He showed generosity and consideration for others which enabled him to be an excellent host of Masonic evenings and on other occasions. In October last year when we visited him we were for the first time introduced to the best parts of Lymm (which we had by-passed for years). When we were leaving his house he insisted on digging us rhubarb and potatoes from his garden. We often received through the post his excellent honey.

As a result of his geological trips both at home and abroad, Bill contributed four articles to *The Amateur Geologist*, and on reading them one soon gets an idea of his eye for country and its rocks, minerals and fossils.

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(Derek Brumhead)

THE COAL MINES OF NEW MILLS: HISTORICAL SOURCES

by Derek Brumhead

INTRODUCTION

The rocks of the district consist of sandstones and shales of the Lower Coal Measures in which there are several thin coal seams. The most widely worked seams are the Red Ash (Little Mine) and the main seam known locally as the "Yard" on account of its average thickness. Below the Yard Seam is the Woodhead Hill Rock, a thick sandstone. At New Mills, it forms the sides of the Torrs, a spectacular gorge 80 feet deep cut by the rivers Goyt and Sett.

The rocks are disposed in a major geological structure known as the Goyt Syncline, an elongate basin with a longitudinal axis treading north-south for several miles. The syncline is a subsidiary fold within the broad dome of the Peak District and this accident of geology has been responsible for the preservation of coal seams. The flattening out of the syncline northwards in the vicinity of New Mills gives rise to a broad spread of rocks with shallow dips, with the sandstones producing a characteristic scenery of scarps and dip slopes, such as Lantern Pike overlooking Hayfield and Cracken Edge overlooking Chinley.

Ollerset and Beard moors to the east of New Mills, where the first serious coal mining took place in the early eighteenth century, are on the eastern flank of the syncline in which the dip of the strata rises towards the east at a gradient of about 1 in 7. Thus near the top of the moors the coal seam approaches the surface and could be reached by shallow pits. In the middle and later nineteenth century shaft mining took place on the lower slopes of the moors where the coal was deeper near to the centre of the syncline.

Mining has also been affected by faults, which throw the strata up or down. This results in variations in the depth of the nineteenth century shaft mines. Burn'd Edge Colliery Number 4 on Ollerset Moor mined the Yard seam at a depth of 66 feet, yet only a few hundred yards away to the south, on the other side of a fault, at Burn'd Edge Colliery Number 1, the same seam was at a depth of 396 feet (Fig.1). It is this fault which prevents the extension of the present Birch Vale Quarry southwards, the sandstone suddenly being replaced by shale. A map and section of the Coal Measures at New Mills is provided in Brumhead (1988).

The medieval and early-modern history of the district was moulded by it being part of the royal forest of Peak, which included all the "dark peak" of north-west Derbyshire and extended eastwards into the limestone "white peak". The region originally formed part of an inheritance dating back to William I. In 1372, excluding the manor of Glossop, it came into the possession of John of Gaunt, Duke of Lancaster. When his son was crowned Henry IV in 1399, it became part of the huge crown estate known as the Duchy of Lancaster.

In 1640, the royal forest of Peak was disafforested (ie the laws abolished), and the deer removed. After the civil war, thousands of acres of common land was sold off to private individuals. But what was important as far as future coal mining was concerned was that the duchy retained the mineral rights even under freehold land. As a result of duchy ownership there is a rich heritage of documents available in the public record office, such as accounts, rentals, agreements, special commissions, and leases which have proved very fruitful sources for the study of coal mining. They have provided, for instance, the earliest known date of coal mining in the region (1598-9) and details of the leasing of the mining rights in the late seventeenth and early eighteenth centuries. The most important discovery is a coal mining account book for 1711-57 (purchased by the Derbyshire Record Office at an auction) which gives week-by-week accounts of the coal mined on Ollerset and Beard moors over a continuous period of 46 years, recording a partnership of three men.

There is a wide variety of other information including mine abandonment plans, Ordnance Survey and Geological Survey maps, records of mine accidents, reports of the inspectors of mines, and information from the mines record office. There are miscellaneous documents in the hands of the local history society and private individuals, while the Derbyshire Record Office holds duchy documents not in the Public Record Office, and census, poor rate and land tax returns. The records of New Mills Town Council have a number of miscellaneous documents relating to coal mining after the first local board was established in 1876 and these are now held in the archives of the New Mills Local History Society. A valuable reference for the early nineteenth century is John Farey's Survey of Derbyshire.

DUCHY OF LANCASTER PAPERS

These are available in the Public Record Office (PRO) or the Derbyshire Record Office (DRO). The documents cited below are a selection of some of the most important and are examples of some of the information which is available.

A rental of the time of Elizabeth (1558-1603), PRO, DL 43/1/25.

John Rylands library, Manchester. Bagshaw muniments 13/3/136, dated 23 June 1702. This lease demises the coal mines within the parishes of Chapel and Hope and the tollage passage and stallage of the markets and fairs of Hayfield which had been demised on 2 April for 31 years from 29 September 1684 for a yearly rent of 2s 6d for the tolls and coals.

DRO, D1673, is a miscellaneous collection of Duchy of Lancaster papers which includes papers on coal mining in the High Peak.

PRO, DL 44/1285, Special commissions and returns.

PRO, DL 41/62, 1773-1817. Collieries and stone quarries, Derbyshire. Includes various papers on the coal mines of the New Mills district 1800s-1820s.

A commission of 24 June 1801 to survey the Rev. Simon Jacson's collieries in the High Peak. PRO, DL 42/164 Miscellaneous Books 1769-1806, p 133. The lease was granted following a "memorial" from Rev. Roger Jacson on behalf of his father Simon Jacson who was blind requesting a new lease upon a term of 31 years throughout the whole district of Bowden Middlecale.

The collieries were leased to Rev. Simon Jacson on 3 February, PRO,DL 42/165 (1806-1813), p 203. Jacson immediately set about sub leasing these collieries. A lease dated 14 September 1810 demised collieries called Ely Bank, the Shaw Marsh, New pieces, Polls coalpit, and the New Mill or Eaves Knowl coal mine to Ralph Bower. Rent £120, with no mention of any royalty although the amount of coal extracted was to be measured and certified. PRO, DL 42/166(1813-16), p. 68. See also two leases dated 1810 (coals in Bugsworth and Thornsett) and one dated 1814 (coals in White), Cheshire Record Office, DDW/3765/128/4).

The lessees were required to "mark out upon the surface of the ground the extent of the coal worked beneath the same that the quantities of coal got and the rent to be paid for the same might be with greater certainty ascertained...". These conditions heralded the new economic climate at the beginning of the nineteenth century and the approach to coal as a valuable economic resource and capital asset. Previously, leases had been no more than licences to mine coal. Rents were very low and royalties were not charged.

COAL MINING ACCOUNT BOOK 1711-57

It was under a Duchy of Lancaster lease of 1702 that John Shalcross sublet the coal under Ollersett and Beard moors to three partners - John Mottram (Peter Mottram from 1749/50), William Carrington and William Sennett. The work of this partnership is enshrined in the pages of an account book, covering the period 1711-57 (DRO, D 3226 Z/I/1). Consisting of 163 closely written pages, it records the first serious period of coal mining in the New Mills district. All the mining recorded takes place on the isolated upper slopes of Ollersett and Beard moors, which rise to over 1000 feet between New Mills and Chinley. Near the top of the moors the coal seam approaches the surface and could be reached by shallow pits. The large quantities of coal produced suggests that they were not bell pits and that coal was extracted from extensive areas around each pit. This is supported by the frequent reference to payments for "dead work", ie not winning any coal. The account book was purchased at a London auction a few years ago; a fuller description is provided in Broomhead (1992)

JOHN FAREY

Reference must be made to John Farey Senior who played such an important role at the beginning of the nineteenth century. Farey was one of the most outstanding of the earliest professional geologists and mineral surveyors. His three-volume book presents the results of a survey of the agriculture and minerals of Derbyshire which he conducted in 1807. A reprint has been issued of Volume I which includes his list of collieries in Derbyshire, running to twenty seven pages (Vol I pp. 185-215). The reprint also includes a modern appreciation of Farey including a bibliography of his writings.

The list of collieries includes ten from the New Mills area:

Aspinshaw, W of Hayfield,in Glossop,2nd Coal
Bank-end, NE of Disley, in Cheshire, 2nd Coal
Broadhurst-edge, 1¼m SE of Mellor, in Glossop, 2nd Coal
Bugsworth, NW of Chapel-en-le-Frith, in Glossop, 2nd Coal
Burn'd-edge, in Ollersett, SW of Hayfield, 2nd Coal
Eaves-Knowl,(Bower's and Longden's Pits), W and SW of New Mills,in Glossop, 2nd Coal
Lower-house (or Cucko-bush Hill), 3/4m SW of New Mills, in Glossop, 2nd Coal.
Moor Top (Top of Moor) near Chinley, 2nd Coal.

For mine, one third m. SW of New Mills in Cheshire, 2nd Coal.

COAL MINING LEASES

Mineral leases differ from leases of land either for agricultural or building purposes, at the end of which the value of the land should either remain the same or be increased. A mineral lease is, properly speaking, a sale of minerals in consideration of certain payments spread over a term of years, and the lessee expects during the period of the lease to recoup the whole of his capital expenditure upon mining the minerals, erection of buildings, machinery, etc, together with interest, and compensation for the risk which he undertakes, and the skill which he bestows in the conduct of such operations (*Royal Commission on mining royalties. Final report*, London, 1894).

New Mills is fortunate in having a superb collection of nineteenth and twentieth century coal mining leases, which were found quite fortuitously for sale in a Manchester secondhand bookshop ! They give rich information on the geology, the extent of the proposed concession, the length of the lease, the type of rent and royalties, the payment of wayleaves if any, the right to erect engines and buildings, the right to drive roads, tramways or tunnels, and covenants regarding damage to land and stock. 24 coal mining leases between 1825 and 1922 were summarised in Brumhead (1987).

MINE ABANDONMENT PLANS

In addition to the leases, New Mills is fortunate in that there is in New Mills Library almost a full set of 40 mine abandonment plans of the local collieries. These are also summarised in Brumhead (1987).

GEOLOGICAL SURVEY SIX INCH MAPS

A major source for studying coal mining are the six-inch (1:10,560) maps of the Geological Survey of Great Britain. Six inch geological maps have been published for all the coal mining areas and they form an underused resource for the historical study of coal mining. As well as the primary geological data including coal seams and the dip of the strata and faults, all the information recorded on the mine abandonment plans is included such as adits, tunnels, pits, and depths in the pits to the coal seams. However, information about coal mines before mine abandonment plans were available, ie 1872, is not shown.

This is the reason why the Meadow Street shaft was not shown on the six-inch map (see below).

The sheet numbers of the local maps are: SJ 98SE, SJ 998E, SK 07NW, SK 08NW, and SK 085W.

ORDNANCE SURVEY 25 INCH MAPS

There is also topographic information about coal mining on the Ordnance Survey 25 inch maps, which in the New Mills area go back to the late 1870s. They are particularly useful for showing the lines of tramways. Coal heaps, since they are topographical features even when many years old, are also usually shown. The importance of this when there is no abandonment plan available was dramatically illustrated in the case of an old shaft discovered when an extension to a school car park was being made near Meadow Street in New Mills. No abandonment plan available, but the Ordnance Survey 25 inch map showed a "hairy caterpillar" near the site. Suspecting this to be the spoil from an old shaft, the clerk of the works arranged for a JCB to clear the ground. A disused shaft, later found to be over 200 feet deep, was uncovered.

The sheet numbers of the local 25 inch maps are: 1st Edition 1880, 2nd Edition 1898-99. Sheets: Derbyshire v:10, v:11, v:14, v:15, v:16, viii:2, viii:3, viii:4, viii:7.

DUCHY OF LANCASTER MINERAL MAPS

For many years the Duchy of Lancaster's agent was William Eagle whose offices were in Manchester. An unusual discovery quite recently was a set of Ordnance Survey 25 inch sheets of the various collieries in Whaley Bridge and New Mills in the late nineteenth and early twentieth centuries. The colliery workings are coloured in great detail to show the coal extracted at different dates. These unique maps appear to have been deposited in the 1950s by someone from the former Duchy mineral surveyor's office, and were only "discovered" by the author a few years ago, their significance not being recognised before then.

I am grateful to Margaret le Motte of the Local Studies Unit at Manchester Central Library for drawing up the list of these maps:

Derbyshire 1880 Edition

v.25 Burnt Edge Pit, Little Mine, New Pit Pingot, Thornset Hey
viii.3 Pingot, Beard-Ollerset, Beard and Bugsworth
viii.7 Bugsworth, Beard and Bugsworth, Lady Pit, Dolly Pit
viii.11 Ringstones, Whaley Bridge, Bugsworth, Waterloo
viii.15 Shallcross

Derbyshire 1898 Edition
v.10 Thornset Hey
v.11 Thornset Hey (Aspenshaw)
v.14 Thornsett Hey, High Lee
v.16 Burnt Edge
viii.4 Berry Edge
viii.15 Waterloo
xiv.3 Fernilee

Cheshire 1872 Edition
xx.15 Redmoor Lane, Bank End
xx.16 Furness Clough
xxix.3 Diglee
xxix.4 Ringstones, Whaley Bridge
xxix.8 Whaley Bridge

PROBATE DOCUMENTS

Probate documents occasionally provide references to coal mining such as this extract from the will of William Carrington The Elder of Ashton [Ashen] Clough. Will dated 9 June 1725:

> "Item my will and mind is that my sonn William Carrington do give and allow unto his brother Joshua Carrington the quantity of tenn loads of Coals yearly and every year before each Christmas he paying the work and wages during the continuance of tenure of the coalemines".

INSPECTOR OF MINES REPORTS

Details of fatal accidents in New Mills mines are given in the following reports:

1855 22 January Ollerset Colliery. William Cooper. Suffocated by

choke-damp.

1879 Aspinshaw. Joseph Bennett, 25, stallman. Fall of roof. Deputy cautioned the deceased not to enter the stall, but he did not fence it off.

1880 Beard and Bugsworth. Joseph Hill, 19, trammer. Roadway too small; sub caught a prop and knocked it out, roof fell upon deceased.

1882 Thornsett Hey. Samuel Pott, 50, Miner. Unramming a missed shot, when it exploded.... Workmen were engaged in clearing away, and making way for an underground engine and they found it necessary to blast the floor. Samuel Pott and another man, drilled and charged a hole for the purpose, the fuses were lighted, and the men retreated some distance out of the way. They waited a short time, but finding the shop had mis-fired, they went back to it, and by direction of the underviewer proceeded to drill it out, and whilst so engaged a spark from the side came into contact with the powder, causing an explosion, which mortally wounded Samuel Pott. [The underviewer was later charged at the Chester Assizes with manslaughter and found guilty. On account of his long service and previous good character he was recommended to mercy and sentenced to four months imprisonment without hard labour.]

1883 Aspenshaw. John Thomas Florey, 25, stallman. Fall of roof.

1884 Aspenshaw. John Bramall, 50, stallman. Fall of roof; place insufficiently timbered.

1888 Burn'd Edge. Joseph Bowden, 28, labourer. Assisting to take arch off the top of an old coal pit, and is supposed to have slipped; fell down the shaft.

1891 Birch Vale. Benjamin Howard, 39, Deputy. Fall of roof. Withdrawing back timber by knocking it out with a hammer, and standing under roof, instead of using a ringer and chain. Died 8th May.

1906 Birch Vale. William Barker, 65, header. Fall of roof, deceased was working in the end of a narrow heading when a large stone fell from the roof and killed him. An item in *Echoes from the Peak* in the High Peak Reporter for 28 July 1906 described this accident:

> Last Friday a collier name William Barber (sic) was left working at the Thornsett Colliery, and when the deputy went down to see how much

more coal he had to get, he found the poor man lying dead, in a crouching position, with a huge stone on his head and shoulders, and buried in loose coal. He had been a collier for 50 years. What a shocking death after all these years of hard work! How little people think of all those dangers, when they sit by a cosy fire, and follow less dangerous occupations, which could not be carried on without the aid of coal which the colliers get. They ought to have every sympathy and the best of pay in their dangerous work". (Reprinted in Bill Williamson's column, High Peak Reporter 28 July 1991).

MISCELLANEOUS DOCUMENTS FROM NEW MILLS LOCAL HISTORY SOCIETY ARCHIVES

Report of a Survey by Messrs Cross and Eagle, Mineral Surveyors for the Duchy of Lancaster, of the workings by Mr Levi Joseph Hall at the Beard and Bugsworth Colliery in the coal mines under the "old lands" of the Haugh Estate and an estimate of the rent accruing from Commencement (Lease dated 11 May 1898) to 29 September 1898.

Letter from L and E Hall to J E Braddock of the Haugh dated 16 July 1894 headed "Haugh Coal":

> About 280 yards down our Engine Brow at Beard and Bugsworth Colliery, we have our East level, the end of which is near to the boundary of your Freehold Coal.
>
> If agreeable to you, we are willing to continue this level (and, other necessary straight work for ventilation, water, etc) some distance in your coal, with a view to prove it more fully.
>
> We would pay you a royalty of five pence for each four waggons of coal gotten from your Freehold Estate.
>
> An accurate account of the number of waggons of Coal gotten from your Estate would be kept.... You or your Agent to have reasonable liberty to inspect, and to survey the coal workings...

A further letter dated 1 October 1896 requested a reply to the above. A letter dated 5 February 1900 from J W Broadhurst (nephew of J E Braddock) headed "Old Water level pillars" accepts the offer of 2nd instant viz "Three pence per ton for Each four waggons of Coal gotten".

POOR RATE AND LAND TAX ASSESSMENTS

Poor Rate Assessments and Land Tax Assessments are not so informative as one might have hoped. Thus the "Poor Rate Assessment made by the Overseer of the poor of the hamlets of Beard,Ollersett, Whitle and Thornsett....after the rate of threepence farthing the pound yearly value of all the estates within the said hamlets....on the fifth day September 1768" includes:

Ollersett. Mr William Carrington for one coal mine.... 0.1.7½

Whitle. Mr William Carrington for a coal mine... 0.1.1

REPORTS OF THE MINES RECORD OFFICE

These provide details of the numbers working at certain collieries between 1894 and 1933.

CENSUS REPORTS OF GREAT BRITAIN

The number of persons and places of residence employed in coal mining in the second half of the nineteenth century in New Mills can be found from the enumerators' returns of the censuses of Great Britain held in 1851, 1861, 1871, 1881, and 1891.

PAPERS OF THOMAS OLDHAM, BOILER MAKER

Tom Oldham, a member of New Mills Local History Society, has generously provided extracts from the business correspondence of his grandfather who was a boiler maker in Heaton Norris and did much work for New Mills collieries in the late nineteenth century and early twentieth century.

12 February 1885. Thomas Bennet Esq., Thornsett Hey Colliery:

> "I propose to cut up the boiler I fixed for you in the above colliery into pieces similar to what it was when taken up to its position, and use every care to keep the plates good for putting together again. You to provide candles and all light, and remove plates as the work proceeds...."

25 November 1887.	Supplying valves, Fittings etc and doing work on a Boiler (113 hours) At Burnied Edge Colliery Co...£9. 11. 7
27 November 1888.	The Aspenshaw Coal Co. Supplying one Second Hand Boiler.....£110. 0. 0
8 December 1888.	Fixing Boiler at Colliery 4 men a total of 233 hours. Carrage £11.....£23. 12. 7.
26 January 1889.	Aspenshaw Colliery Co Repairing Small Boiler....£2. 15. 0
June 1888.	The Pingot Colliery Co One Second Hand Boiler....£60. 0. 0 Delivery Charge £10. Cost of installing £6. 15. 9.....£16. 15. 9

21 March 1895. The Aspenshaw Colliery Co. An extract from a lengthy quotation for a Lancashire Boiler 6' 2" diameter x 24 ft long:

"The boiler to be built up here and removed in parts to your colliery, and moved up the tunnel by you in parts, and erected and finished off by me. You to provide the bed. Price £350."

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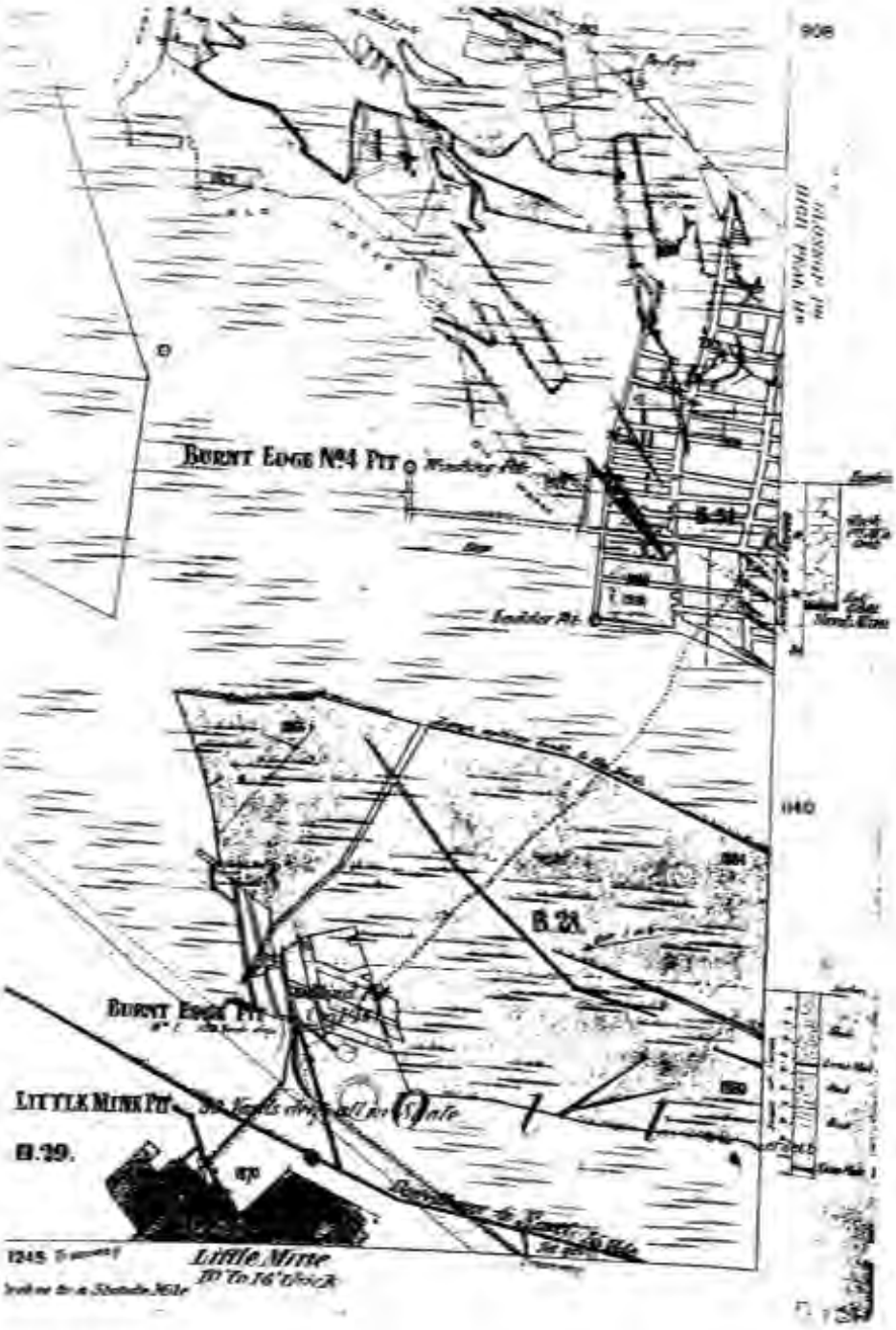
Figure 1

The workings of two collieries on Offerton Moor in the late nineteenth century, showing some pillar and stall, coloured on the Ordnance Survey 25 inch map (first edition 1879). The shaft to the Yard Coal at Burnt Edge No. 1 was 396 feet deep. The coal is upthrown to the north by the fault shown, so that the shaft at Burnt Edge No. 4 is only 66 feet deep. Little Mine Pit was 91 feet deep to the Red Ash coal, the only other seam worked in the area. Immediately above this coal was the *Gastrioceras listeri* marine band. Specimens of this goniatite can be found on the present spoil heaps. Note the tramways which served the pits on the moor, taking the coal down to the nearest road about one mile away. They are marked on the original OS map.

Reproduced from a copy of the Duchy of Lancaster mineral agent's map provided by the Local Studies Unit at Manchester Central Library. The collection of seventeen 25 inch mineral maps covering Whaley Bridge and New Mills are now in the archives department.


Burnt Edge No4 Pit
Ladder Pit
B.21
Burnt Edge Pit
Little Mink Pit
B.39.
Little Mine

THE ASSET ON THE BALANCE SHEET

by Hilary Davies

In the introduction to their book, Anderton *et al.* (1983) remark that the teaching of stratigraphy "has long been regarded as dull and overburdened with tedious detail". Their book was "an attempt to break the traditional mould". However, members of the Liverpool Geological Society (LGS) have never had any reason to think of stratigraphy as dull. Indeed the link with stratigraphy is what has made the annual presentation of the Treasurer's accounts into an "enriching" experience as members contemplate the value of the asset on the balance sheet - an original copy of the 1815 geological map by William Smith, the father of stratigraphy.

Probably no more than 10% of the original 410 maps survive (Eyles & Eyles 1938) so few geologists have ever had the chance to see and appreciate Williams Smith's work. Those maps that have survived are carefully curated in dim museum vaults. It was for this reason that LGS decided to produce a replica map which could be put on general display and which could be reproduced in poster form for general educational use. Now that the poster is on sale, it is appropriate to set down some of the background to William Smith's work in a readily accessible form for members of the Society and others in the north-west. There are several papers which deal with various aspects of Smith's work and these are listed in the reference section.

Because of the demands of the 20th century petroleum industry, stratigraphy has evolved into a high-tech branch of geology, but the aims remain the same, i.e. to relate layers of rock in a time sequence and from one locality to another. Even those who studied rocks before the word "geology" had been coined were aware of a certain sense of order: coarsely crystalline rocks underlay sedimentary rocks; non-fossiliferous underlay fossiliferous rocks (Bynum *et al.* 1983). But as Fuller (1969) has pointed out it was the demands of industry in the form of the industrial revolution which led to the first great developments in stratigraphy.

William Smith was born into these industrial revolutionary times on 23 March 1769 in Churchill in Oxfordshire. After his father's death in 1777 and his mother's remarriage 2 years later, he was left to live his teenage years with his father's older bachelor brother, another William Smith.

The Britain of the late 18th century was a place of rapid population

growth. Between 1720 and 1820 the population doubled from 7 to 14 million, caused mainly by a fall in mortality rate due to better hygiene. Feeding of these increased numbers became a top national priority and surveyors were sent out to "enclose" the best corn-growing areas. It was this revolution in the farming industry which provided the first stepping-stone in Smith's career. His schooling had finished at the age of 11, but he was bright enough for his uncle to arrange for him to serve as the assistant to the surveyor, Edward Webb, when he arrived in Churchill in 1787. Smith made a good enough impression to be offered employment in Webb's business based in Stow-on-the-Wold where he was trained for the next 5 years.

In October 1791, Smith was sent to carry out a survey of the estate of the late Lady Mary Jones of Stowey in Somerset. This provided a second fortuitous stepping-stone in his career. Mary Jones was the niece of John Strachey FRS (1671-1743) who had published an account of the arrangement of coal-bearing strata in the mines of his estate. Fuller (1969) indicates that it is likely that Smith would have read the papers by Strachey left in the estate, and these may well have been his first introduction to thinking about strata in three dimensions. Smith resided at Ragborne Farm, High Littleton whilst the survey was undertaken and he was later to refer to this place as the birthplace of English geology (Phillips 1844).

His skills as a surveyor attracted the attention of the local coal pit owners and in March 1793 they set up a consortium to engage Smith to draw plans for a possible Somerset Coal Canal to link into the already existing Kennet and Avon Canal. Here again we can see how the industrial revolution and the consequent demand for coal was shaping Smith's career. After a Parliamentary enquiry at which Smith gave evidence, the canal project received approval and Smith was engaged as a consultant to oversee the construction. The cutting of the canal gave him a 3-D view of the strata. It also enabled him to extend his fossil collection, begun as a child, and led him to make the momentous and frequently quoted note in his diary:

> '*Fossils* have long been studied as great Curiosities collected with great pains treasured up with great Care and at great Expence and shown and admired with as much pleasure as a Child's rattle or his Hobbyhorse is shown and admired by himself and his playfellows - because it is pretty. And this has been done by *Thousands who have never paid the least regard to that* wonderful order & regularity with which Nature has disposed of these singular productions and assigned to each Class its peculiar Stratum...".

in this, Smith shows that he had realised the stratigraphic significance of fossils (Cox 1942).

After a disagreement with the canal company Smith's consultancy was terminated on 5 June 1799. This left him free to set up as an independent consultant and his services were quickly in demand. This time it was nature which took a hand in shaping his career. The period from 1770 to 1810 is documented as having particularly cold and wet winters (Brown 1996). All the major English rivers for which records are available, repeatedly reached flood levels which today would be expected to have a recurrence interval of 200 to 300 years. This period of rather erratic climate was attributed by Lamb (1982) to a high frequency of explosive dust-creating volcanic eruptions around the world, but whatever the explanation it guaranteed Smith's success as a freelance drainage consultant and set him up financially to fund his growing passion to map the strata. The consultancies also provided the opportunity to travel and his diaries record him working the length and breadth of the country, from Scotland to Sussex and from Snowdonia to Suffolk.

Many of his business contacts were made at meetings of local Agricultural Societies and it was at the Bath Agricultural Society meeting of 1799 that he was introduced to the Rev. Benjamin Richardson and the Rev. Joseph Townsend, both of whom were interested in fossils, like many other churchmen of their time. Smith introduced them to the stratigraphic significance and after a field excursion to Dundry Hill, Smith dictated and Richardson wrote down the first ever Table of Strata, the original of which is now in the possession of the Geological Society of London. This event is commemorated by a blue plaque outside 29 Great Pultney Street, Bath, which was Townsend's home. Both men circulated the Table of Strata widely to colleagues all over Europe, fully expecting that Smith would formally publish his data. But Smith's career was held back by his feeling of literary inadequacy and he contributed very little to the scientific literature of his time.

As well as making business contacts at the Agricultural Society meetings, other important annual events were the sheepshearings. Smith appears on a painting by George Garrard, of the Woburn Sheepshearing which still hangs at Woburn Abbey. It was at the Woburn Sheepshearing of 1804 that he first met Sir Joseph Banks, President of the Royal Society. Banks was keen to promote Smith's plans for a geological map of England and Wales and he opened a subscription list and invited subscribers to the project at five guineas a head. This encouraged Smith to go on collecting data. He also remained hopeful that the Geological Society of London, which was founded in 1807, would sponsor his map and he invited members to his London home, which had been bought

purely to house his fossil collection, to view his plans. The Chairman, George Bellas Greenhough, an academic of the Neptunist tradition, and Smith, who was very practical and not very scholarly, did not get on, so the Geological Society was advised not to back Smith's venture.

The map subscription list itself is an interesting catalogue of Dukes, Marquises, Earls, Viscounts and Baronets, who were probably grateful customers whose estates Smith had successfully drained. By 1812 Sir Joseph Banks had received enough subscriptions to make publication possible and John Carey of The Strand, London undertook the task. First, Smith ordered a new base topographic map to be created at 5 miles to 1 inch bearing place names specially selected to be of physical significance. The country was divided into 15 sheets and work began with sheet 1, the far north-west sheet which overlapped into Scotland. Because of Smith's desire to have every detail correct he spent much of 1813 and 1814 collecting more data so it was not until 8 February 1815 that the whole map was finally ready for printing. This initial copy was lodged with the Society for the Encouragement of the Arts which was the only body to give him a grant (£50) towards his costs.

Hand colouring of the first sheet began on 14 May and was completed 7 days later, and on 23 May 1815 Smith formally presented the first map to the Board of Agriculture under the title:

> A DELINEATION OF THE STRATA OF ENGLAND AND WALES, WITH PART OF SCOTLAND; EXHIBITING THE COLLIERIES AND MINES, THE MARSHES AND FENLANDS ORIGINALLY OVERFLOWED BY THE SEA, AND THE VARIETIES OF SOIL ACCORDING TO THE SUBSTRATA, ILLUSTRATED BY THE MOST DESCRIPTIVE NAMES.

The map is dedicated to the Right Honourable Sir Joseph Banks Bart PRS, by his most obliged servant W.Smith.

The original publisher's literature indicates that for an extra fee the 15 map sheets could be mounted (full size 8' 6" inches x 6' 2 ") on canvass with spring rollers. Certainly maps sold in this form would not have stood the ravages of time. Eyles & Eyles (1938) tracked down 27 extant maps and highlighted the small ways in which the publication evolved from 1815 to 1817.

The production of the maps to satisfy the subscription list went on throughout 1816 and 1817. Four hundred and ten were produced in all, but such were the production costs that Smith himself made no money out of the

project and production was halted. The Geological Society had been persuaded by Greenhough to commission him to create another geological map just like Smith's and the pending publication of that map with its seal of approval from the Geological Society was the final nail in the coffin of Smith's publication.

The production of the map had led to the neglect of his business and this, together with some unwise property ventures, left Smith in financially straitened circumstances. In 1816 he had to offer his fossil collection (some 2,657 specimens from 693 species) for sale to the British Museum in order to raise some cash. By 1819 he had been declared bankrupt and spent 10 weeks in prison. On regaining his freedom he vowed to leave London and never to return. He always found it hard to come to terms with his rejection by the more academic geologists. However he was not entirely alone. The cataloguing of his fossil collection had been undertaken by his nephew, John Phillips, and he remained with him for the rest of his days, which were spent either travelling or living in Yorkshire. Phillips himself received an excellent geological education from Smith such that Phillips eventually became Professor of Geology, in London, followed by Dublin, finally ending up in Oxford.

It was not until 1831 that Smith received the acknowledgement he deserved when he was awarded the Wollaston Medal of the Geological Society, and in 1832 he was awarded a government pension of £100 per annum which enabled him to live his latter days in comfort. He was a regular attender of the annual meetings of the British Association for the Advancement of Science and it was while travelling to the meeting in Birmingham in 1839 that he was taken ill in Northampton and died on 28 August.

It is thanks to the foresight on G.H. Moreton, the first Secretary of LGS, that the map came into the possession of the Society. When he died in 1900, the family of Mr Moreton donated his map to the Society. It remains the Society's most prized possession and it has been reproduced in poster form in order that more students of geology will be able to gain some appreciation of the work of William Smith and the quality of his observations. For the work of one man it is a remarkable achievement and it is something of a tribute to the man that so many of the colours chosen to represent the strata are still used today on British Geological Survey maps.

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FORENSIC GEOLOGY

by Alan Gurr

Forensic science is scientific investigation relating to law. The first British Forensic Science Laboratories were set up over sixty years ago. The Forensic Service, now an Agency within the Home Office, deals with a wide range of offences. Investigations are carried out, statements are prepared and scientists give evidence when required. Most of the cases are submitted by police forces but some originate from sources such as industry or advocates acting for the defence. Forensic investigation is also undertaken by other government agencies and private laboratories.

The Forensic Science Service (FSS), employing about six hundred scientists, has regional laboratories situated at Birmingham, Chepstow, Chorley, Huntingdon, Wetherby and London, the headquarters being centred in Birmingham together with the DNA database. Major reorganisation is taking place. One laboratory (Aldermaston) has closed and regionalization of particular techniques has occurred. These changes include the move away from departments based on single disciplines (e.g. biology, chemistry, toxicology) to multi-discipline departments dealing with a particular crime type.

The forensic scientist often has only minute amounts of material with which to work and many techniques have been developed to enable a meaningful comparison to be made between samples. For example, a few tiny half millimetre sized fragments of glass recovered from an item of clothing can be compared with a control sample taken from a broken window at the scene of a crime, using an automated hot stage apparatus to determine the refractive index of the glass. A large amount of information has been gathered over many years to which the scientist can refer in providing the court with information concerning the frequency of occurrence of various types of glass. Similarly tiny paint flakes can be mounted under the microscope and the colours of the layer structure established. It is even possible by scanning electron microscopy to analyze individual layers.

Geological materials, other than of course glass, generally require much larger samples for viable comparison purposes because of their more heterogeneous nature. Various instrumental techniques are available including x-ray diffraction, x-ray fluorescence and infrared spectrometry. Very often the examination is restricted to microscopy due to the limited amount of sample available but even the most ubiquitous of materials, building plaster, can

provide useful evidence. Gypsum plaster is so soft that within a very short time it is lost from a garment so that it is extremely rare to find plaster dust on clothing unless the person is known to have had very recent contact with broken plaster. The forensic geologist can therefore provide the courts with valuable information. The examination of soils is mentioned later but the following cases are examples containing a geological content.

Three lorries disappeared from a yard in Leicestershire. They had been employed in transporting crushed rock from a quarry near Nuneaton. Some months later a scrap yard in Hampshire was visited by local police during a major conspiracy investigation. Wheel axles and other lorry parts coated with red mud were discovered and the police wanted to establish whether these components were part of the missing lorries. Rock debris embedded in the mud was examined in the laboratory, some of the fragments were even large enough for thin sectioning, and found to correspond so closely with the range of rock types present in the quarry at Nuneaton that the vehicle remains found in the Hampshire scrap yard almost certainly originated from the missing lorries.

A damaged safe was found in a garden and a lorry thought to have been involved in transporting it from a burglary in Merseyside was seized by the police. The safe ballast which was contained between thin walls of the safe consisted mainly of hardwood shavings. Safe ballast debris was found at the scene, on the lorry and some remaining in the safe. Green granules were found in the ballast and were identified as glauconite closely resembling glauconite from the Greensand of Surrey and Sussex. These granules alone provided strong support for the view that the vehicle was used to transport the safe after it had been damaged.

The theft of roofing slates and flags are all to common and any property left empty adjacent to a road is liable to be attacked. Very often there is nothing unique about the slates one is asked to compare. However useful evidence may be found by comparing the geological attributes of the slates and in addition considering the significance of any moss, lichen, traces of mortar and even paint present. One such case however produced results in an unexpected manner. Numerous new slates had been stolen from a building site. These slates had been marked with crayon by the manufacturer as part of their quality control procedure. A vehicle was found loaded with slate. Police officers selected four slates from the vehicle and four from the site of the theft and requested that any crayon marks be compared. On examination it was observed that the main cleavage of the slate cut the bedding plane at a low angle and there was a prominent coarser grained band which was in the same relative position on two slates in mirror image, one from the control sample and

the other from the vehicle. It was clear that these slates had been split from each other proving conclusively that they originated from the same quarry and most probably from the same consignment. In view of the quantity of slates involved it was an extremely lucky selection by the police officers concerned.

Rock and building debris are often used to replace goods stolen during transit. A consignment of diamonds was despatched to Japan. The box arriving in Japan with the diamonds having been replaced by rock debris. The officer who brought the samples in to the laboratory said, "If this is Japanese rock you are going to be flown out to Japan pronto". To the examiners disappointment the box contained Thames Valley gravels and broken brick ! Another example concerned the theft of platinum which had been replaced by gravel, which was a mixture of igneous and sedimentary rocks. The transit shed at London Airport from where the goods were dispatched was visited by forensic scientists. There was a rack, just inside the doorway, with numerous sacks, dripping gravel, which had originated from several different places in Europe. These were the ballast sacks used when loading the aircraft. It was immediately obvious that the swap had taken place within the airport. So again no free flight abroad.

One of the more interesting cases submitted to the laboratory involved sand and related to a smuggling incident in South Devon. Various persons were arrested in Kent, Sussex, Hampshire and Shropshire. The police forwarded to the laboratory a large number of adhesive tape lifts mounted on acetate sheets. The lifts had been taken by various police officers from the seats of a number of vehicles. There were also pairs of shoes covered in sand and samples taken from car boots and from an inflatable dinghy. A trawler had been observed off Start Bay and was thought to have been used in the smuggling. Several samples of the beach were taken as control samples and these consisted mainly of flint pebbles. The samples were sieved and it was found that the samples from the lower part of the shingle beach contained course sand about three to four millimetres in size but no finer. The granularity of the fragments was unusual, being much more rounded than the usual beach sand. This material was compared with the debris retained by the lifts and an excellent correlation was found between them and the samples from Start Bay. It was surprising to find such large sand grains remaining on car seats and also on footwear some considerable time after contact with the beach.

The forensic examination of soil has daunted many a scientist. There are numerous problems as in the majority of cases it is only the very thin surface layer which is disturbed by footwear, vehicles, clothing, etc. The surface layer of soil is continually changing through plant growth, weathering and

contamination, the latter particularly within urban environments. This layer often contains much vegetable matter and on occasions this material can yield valuable information to the botanist. The heterogeneous nature of soils poses further problems in particular the amount of material required for a meaningful comparison with control samples taken from the scene in question. Sampling at the scene of the crime is not straightforward and further samples have often had to be requested in order to establish the variability of the surface soil at the location. Indeed forensic soil examination requires multiple control samples in order to determine the variability of the surface soil at a particular scene. Samples taken from different spots in a relatively small garden say, thirty feet square, can very often be distinguished from each other using simple tests outlined below.

Over the last twenty years the evaluation of suitable analytical methods for soil has been undertaken at the Metropolitan Police Forensic Science Laboratory, The Home Office Central Research Establishment (CRE) and at the Chorley laboratory. The techniques have included differential thermal analysis of the clay components, sedimentation columns, particle size analysis, pH and polysaccharide content. Particle size analysis using high quality sieves can be employed where there is plenty of sample, e.g. theft of building sand or topsoil where bucket sized quantities are available. One particular method developed at CRE utilised the Coulter Counter, an electronic method whereby very small amounts of particulate is placed in an electrolyte and sucked through a small aperture where it is counted. By changing the conditions a range of particle sizes can be recorded. This latter technique was further evaluated at Chorley. A silt fraction is introduced and a size range within the fine silt category is measured. It meant that small lumps of fine soil no more than a half a centimetre square would provide sufficient sample for meaningful comparison.

The author has examined thousands of soil samples that have been examined at Chorley and it has been found through experience that the most effective comparative method is colour, both dry and ashed. The comparison is best made at the finest sievable fractions (45-63 microns), together with a microscopic mineral/rock comparison of the sand sized fraction of the soil. For the latter examination the larger the grain size the better, but one must ensure that there is sufficient material available of the selected size for meaningful comparison purposes. For a time the Coulter Counter was used in conjunction with these methods, but it was found that the Coulter Counter results tallied so remarkably well with the colour comparisons that it was decided to abandon the technique in view of the lengthy preparation and operating time.

Sometimes it is necessary to discover the origin of a soil or mud. In one

such case a young woman disappeared while on her way home from work. Over six hundred soil samples were collected by the scientists and several police officers over a large area of Greater Manchester and Cheshire during the investigation of this case. A handbag complete with identification, together with a woman's coat and a man's jacket were found in bushes on some waste ground near the Manchester Ship canal. A few miles away some men's clothing had been strewn, as if thrown from a vehicle, on another area of waste ground. The front of the garments were covered with mud and mud splashes. The distribution on the shoes was typical of immersion in a very muddy puddle. A suspect was found and his car seized. On examining the car it was noted that on the underside of the drivers quarter there were heavy deposits of mud. It had the appearance of having originated from a deep muddy puddle and this mud closely resembled the mud on the clothing. During the search for the body police divers found a garden spade in a flooded brick pit close to the site where the muddy clothes were found. Although the spade was never positively identified, two persons who helped the suspect occasionally thought it was the one they had used at his premises. The best correspondence between the mud on the clothing and the vehicle was from a muddy potholes in the track adjacent to the brick pit where the spade was found. If the spade was related to the event it meant that there were three sites to which the murderer visited after committing the crime. Sadly the body has not been found. It is possible that there was another site, where the body was deposited, perhaps the first one on his journey. There was no scientific evidence however to indicate where that might have been. The suspect was convicted based on other factors including numerous cross-transfers of textile fibres. This case featured on television in the program *Indelible Evidence*.

Forensic Science covers a vast area of which geological investigations is only a small part. As mentioned earlier forensic analysis is not just the province of the FSS and many other bodies also undertake such work. Geological cases, for example, are also dealt with by the Earth Science Departments of universities and The British Geological Survey who very often have the most appropriate expertise required for a particular problem and also have access to comprehensive reference collections.

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THE GEOLOGY OF THE FYLDE: A REVIEW OF CURRENT KNOWLEDGE

by Trevor Lund

The Blackpool and Fylde district has attracted little geological interest. Exposures are poor and most of the deep bore hole results have been commercially confidential. The area was re-surveyed in 1968 and the present memoir by Wilson & Evans dates from that time. Surprisingly the same is true to a large extent of the eastern Fylde and Bowland Fells area, centred upon Garstang, which recently has been re-surveyed (Aitkenhead, Bridge, Riley & Kimbell 1992).

Deep under the Fylde occur rocks of the Carboniferous Age. These were proved in the deep well at Thistleton, drilled by British Gas in 1990. The exact nature of the Carboniferous structures found by geophysical surveys of the area are commercially sensitive and not in the public domain. On a visit to the drilling rig with a party of students no collecting of bore hole rock samples was permitted and the depth of drilling was kept secret. The Thistleton well was a highly speculative "wild cat" well, put down to prove the Carboniferous sequence of rocks and the geophysical results. The fact that commercial quantities of gas were found and that these are now used for small scale electricity production proves the potential that must lie under parts of the Fylde.

In order to see Carboniferous rocks at the surface it is necessary to cross over the major Bilsborrow Fault that has uplifted these rocks to form the Bowland Hills (Fig. 1). Good exposures of Carboniferous rocks may be found in many of the streams draining the Bowland Fells towards the Fylde, e.g. Barnacre Brook (GR 5116 4604), where the Upper Carboniferous Millstone Grits of Namurian age are exposed. They are mainly mudstones and turbidite sandstones and of particular interest is the presence of a marine band containing the goniatite *Eumorphoceras ferrimontanum*. These rocks were deposited in deltaic conditions, the marine bands representing periods of marine transgression when the sea level rose and covered the delta.

At the end of the Carboniferous Period the Hercynian Orogeny caused substantial faulting and folding, uplifting the Pennines. The Bilsborrow Fault was initiated at this time and has probably continued moving until recently. The present M6 follows the line of this fault which marks the boundary between the uplifted, Bowland Fells Carboniferous rocks to the east and the downthrown, preserved Triassic rocks of the west. From the exposures of

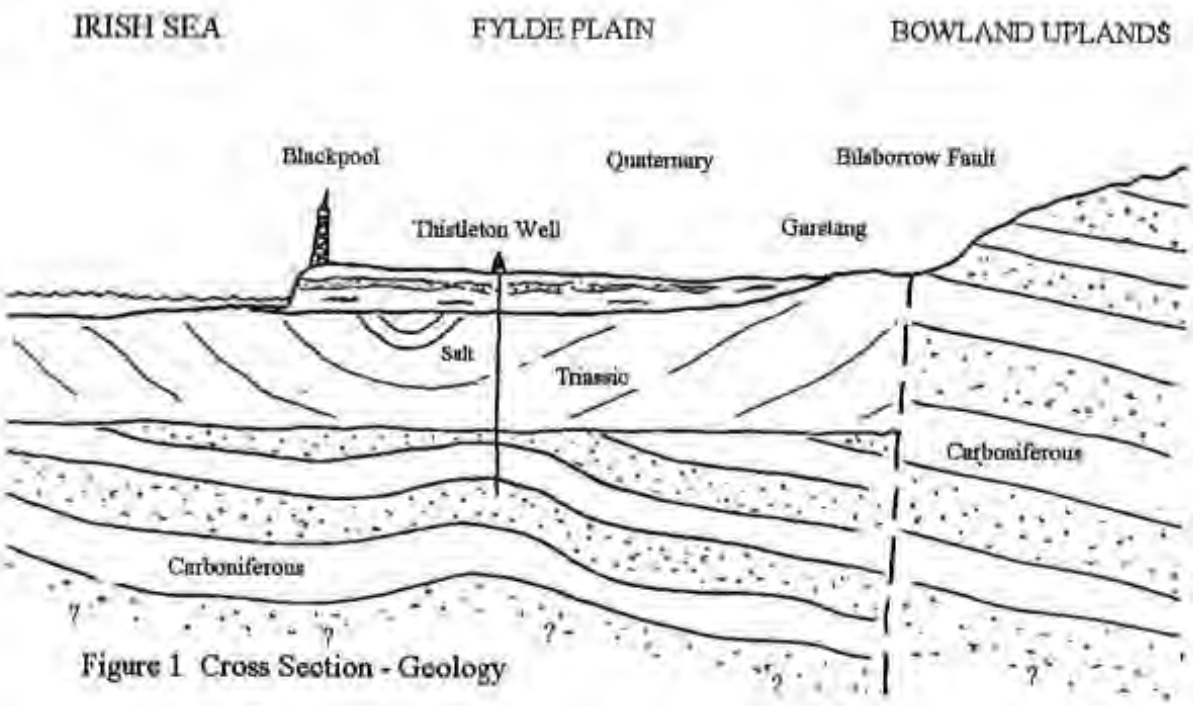


Figure 1 Cross Section - Geology

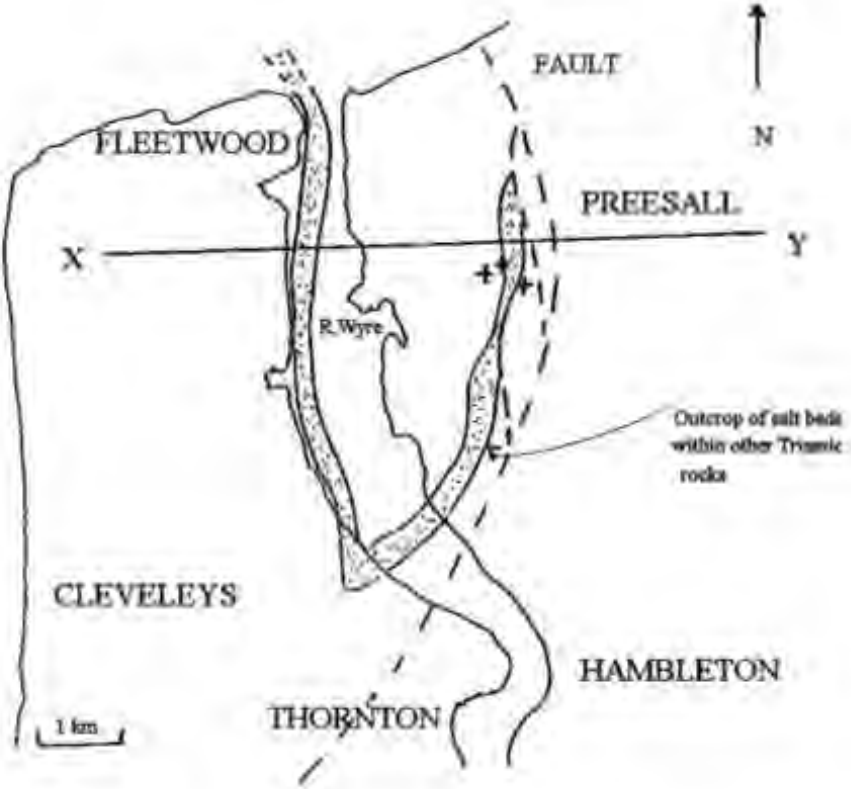
Carboniferous rocks in Barnacre Brook it is possible to walk 700m to the south west, across the M6 and the line of the fault, to see the Triassic rocks exposed in the old railway cutting at Wildgoose Wood (GR 5046 4527). These rocks belong to the basal part of the Sherwood Sandstone and represent the only good exposure of Triassic rocks in the whole of the Fylde. They were deposited in a desert environment as the Hercynian mountains of the Pennines were eroded away. They are typical desert sandstones, reddish-brown, frosted, millet seed grains with some small-scale current bedding. The only other exposure of Triassic rocks is in the bed of the River Brock north of Myerscough which is important in that it allows the Sherwood Sandstone aquifer to be re-charged by water from the River Brock. (In many places on the Fylde, boreholes into the Sherwood Sandstone provide a valuable source of water supply, especially during the summer.)

The Triassic rocks are present under all of the Fylde. The distance through the drift to bedrock is very variable ranging from up to 60m at North Shore to as little as 3m at Burn Naze near Thornton. The Triassic rocks around Preesall contain salt deposits up to 150m thick which have also been proved in over a hundred brine wells and boreholes in the area. The salt was discovered whilst prospecting for an extension of the Barrow Hematite field. Salt was worked underground from about 1894 to 1930 with maxim output of over 100,000 tonnes of salt in 1907. The mine worked by pillar and stall in two levels each about 6m thick. Production of brine for the chemical industry in Thornton started in 1890 and has only recently finished. The salt beds were formed by the repeated evaporation of an inland sea which may have been replenished from time to time by water flowing through a gap in the Pennines from the Zechstein sea in the east.

These Triassic rocks were gently folded during the Alpine Orogeny into a series of gentle anticlines and synclines. Where the salt beds outcrop at the surface, much of the halite has been dissolved away, causing the rocks to collapse (Fig. 2) forming a collapse breccia. It appears that the present course of the River Wyre to the sea follows this line of weakness due to the dissolved salt underneath.

On the Fylde the Quaternary is represented by deposits from the last ice age. During this time from about 50,000 - 120,000 years BP, the Fylde was covered by an ice sheet which originated mainly from the Lake District and which crossed Morecambe Bay. On the eastern edges of the Fylde, ice from the Pennines was dominant.

Moving ice sheets contain considerable quantities of material eroded from



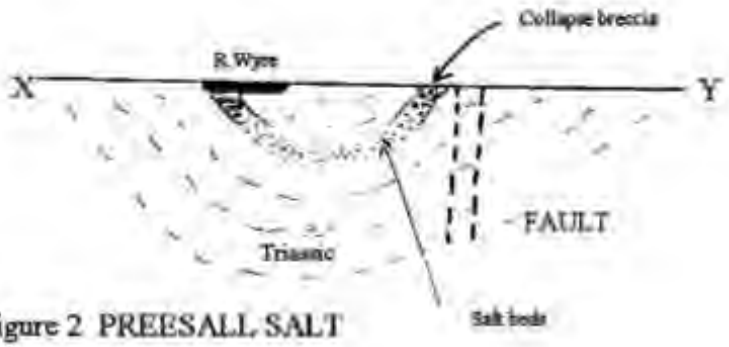


Figure 2 PREESALL SALT

their source area which is deposited when the ice sheet melts. On the Fylde, boulder clay is the product of this deposition. It is found in two layers, separated by a layer of glacial outwash sand. This suggests that there were at least two advances of the ice sheet over the Fylde with a period of meltwater deposition of sand in between. In actual fact the situation is far more complex than this. Shallow boreholes drilled along the line of the M55 and the course of the Fylde Coast Wastewater collection tunnel along the coast, reveal a very variable and complicated sequence of deposits with layers of boulder clay and sand of variable thickness. The sand is not present in some areas and producing a detailed account of the ice sheet is difficult.

These deposits may be seen in several parts of the Fylde, e.g. at Bradley's Sand Pit, near Broughton (GR 511 340), where 2.5m of glacial outwash sand is worked. This shows excellent current bedding, suggesting deposition in fairly fast flowing water. The sand beds contain shell fragments and small pieces of coal. Above this sand is the upper boulder clay. This is a brownish/grey fine-grained clay with occasional pebble horizons present. It is soft, sticky and waterlogged. The boulder clay forms the surface deposit over most of the Fylde. Its undulating nature and impermeability is one reason for the numerous ponds that are such a conspicuous feature of the landscape.

In the north of the Fylde around Thornton and Hambleton the boulder clay has been smoothed by moving ice to form a series of drumlins, low rounded hills of clays, smoothed in the direction of the flow. The view from Stanah Country Park across the River Wyre towards Staynall is the best place to view these (GR 3560 4320).

The final ice melt on the Fylde took place about 14,000 years ago when the sea level must have been much lower than today. (Large quantities of ice were still present over Scotland.) Some of the evidence for this is the fossil forest that outcrops on the beach at Cleveleys (GR 3130 4300). Here, large branches and trunks (Birch?) may be seen, set in a fine-grained, black peat. Following the end of the glaciation, sea level rose rapidly and for a time the northern part of the Fylde was inundated by the sea. Extensive deposits of estuarine alluvium (silts and clay) were deposited on the boulder clay and a few small island drumlins must have been above the level of the sea, e.g. the Stanah drumlins and Preesall Hill (GR 4720 3670). Evidence of this old shoreline may be found around Preesall Hill where old storm beaches run as linear mounds through the fields. These are formed of shingle, sand with some shells. From about 5,000 years BP as the sea level fell, an extensive sheet of peat developed around Stalmine Moss and also to the south of Blackpool at Marton Moss.

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(This paper is based on a talk given at Fleetwood Museum in March 1997.)

ASHTON MOSS REMEMBERED

by Harry Holliday

A gentle giant of an Irish coal miner was working with his two English mates in the "Colonel" seam at Ashton Moss Colliery; this coal is also known as the Ashton Great Seam. A conveyor belt was running just off centre of the passage and this machine created a lot of noise and was a complete stopper to conversation between the three men. To do the ripping job that had been set for that day, they had to resort a lot to signs and gestures across the passage. The two Englishmen were on the one side of the conveyor and Paddy was on the other for he was on his own very strong.

Suddenly there was a great crashing sound and the two looked up with a start. Alan saw that Paddy had gone and a great slab of shale, many feet long, had fallen out of the wall. Worse still there was no sign of Paddy at the spot that he had been working. The third miner ran off down the passage at break-neck speed to hit the stop button on the belt, for it was not possible to cross over it when it was still running.

Just as it slowed down and Alan was making ready to jump over the obstruction, a great dusty apparition reared itself up from the stone,dusted itself off a bit and said to Alan in a quiet voice, "Jaysus, a man could get killed down here !". Because Paddy's way was mild and unassuming, he would not go back for treatment as they would send him off shift for the day. So the three men worked on for the rest of the shift, Paddy's arms dripping blood and his hands and shoulders badly bruised. However, he should have gone out, for it was a full six weeks before he returned to his work at the Ashton Moss Colliery.

From its inception in 1879, to its closing down, about 80 years of coal production had taken place at this pit that had once been called the New Moss Colliery. A very deep pit at over 3,000', ventilation tunnels had been driven in the later years to connect with the Oldham pits called Woodpark and Oak Collieries. A large diameter tunnel was driven to join with the Bradford Colliery, under the houses and factories of the city of Manchester, a smaller one joined Bradford to Moston Colliery two and a half miles away. To complete this ventilation triangle a tunnel connected Moston Pit back to Ashton Moss, a further three miles distant.

Moston Pits No. 4 shaft and fans gave ventilation for some time to the other ones that were still cutting coal, even after Moston itself had shut down

its own production. In the days just after Ashton Moss itself had closed down, a small force of miners were kept on to remove machinery for use at other pits in the coalfield; many metal parts were salvaged and electricity cables were cut and pulled off the gallery walls, in some cases to be sent for scrap.

Two of the men were detailed to descend to the bottom of the shaft on this particular day, but the shaft guides or conductors had already been removed. These conductors keep the cage from turning round in ascent or descent and more importantly stop the cage from hitting the shaft sides. Because of this the cage could only descend at a very slow speed when men were being taken down. At these times of clearing up much of the safety had to be sacrificed in order to get all the jobs done; indeed the men had to put up with a great deal.

As the two men were lowered down, the cage sometimes struck the shaft sides creating a shower of sparks, and pieces of stone were knocked off, to hurtle down into the blackness. After banging into some unseen pipework that was still fixed to the shaft side, Alan thought how different the sound had become now that most of the fittings had gone; this lifeless empty void had once rung with the sound of mens' voices as they sped to work over 3,000' below at 50 mph.

Alan's mind was brought back to reality by a loud grating sound from the cage bottom and the tortured shaft side; the floor of the cage tipped over at an alarming angle, so much so that they were not able to keep their feet on the bottom, and so had to stand partly on the cage side. They both braced themselves with difficulty each in his own corner, and in silent unspoken fear they realised that the cage had stopped descending. Their real dread was that the steel cable that was their only lifeline to the surface was still being wound down and was coiling itself on to the roof of the cage. This great steel cable that is capable of moving all things above pit bottom was now adding to their desperate situation, for heaven alone knew how secure was the projection that kept the cage hung on to the wall of the shaft. The two frightened men had no means of contact with the engine man up top, and so it was a great relief when the cable stopped descending and after a pause of some seconds was heard to start winding and uncoiling itself up off the roof, and in a few minutes more they were being drawn up to daylight.

The projection had served them well as it held them quite safely. Had it broken with surplus cable on the roof above them, the two would have hurtled down at an ever increasing speed in a great shower of friction sparks as the cage were itself away on the unyielding shaft walls. Thankful that the

engine man had realised that there was no weight on his wind, when they reached the surface the two very relieved miners adamantly refused to descend again, and were only too glad to consign Ashton Moss Colliery to memory.

AUTHOR'S FOOTNOTE

These true stories were related to me by a former Ashton Moss miner. By sheer chance, about six months after writing the above, I was at Glodwick Lowside in Oldham, watching a coal shaft being grouted. This is a system for filling up any open spaces in the debris that has been tipped into a shaft at the end of its working life. The grouting then makes safe the shaft for ever on land that is returned to public use. The operator of the rig that I was watching said that he had grouted an awfully deep shaft called *Snipe Colliery*; this is the local name for Ashton Moss.

A few years before, while doing this shaft, the drill had penetrated about half-way down when the rods stopped moving down. The drill still turned in the hole and so after a worrying hurried discussion it was decided to bring up the drill from the depths and start again in another spot. Just as the drill tip came out, it was seen that all of the material that had been the bit had disappeared, and the last rod lifted was at least 10" shorter than when it went down. The rig was then moved over about one foot and a new hole was commenced, this time with success, and in time the bottom was reached and the grouting successfully completed. It struck me that this very girder, that lay in the path of the drill bit, may also be the object that impeded the progress of the cage's descent in those last days of the working colliery ?

POWER FOR FREE - THE NENTHEAD HYDRAULIC COMPRESSORS

by Harry Holliday

In these days when all sources of power have to be paid for in hard cash with ever rising costs, it can be very refreshing to look back to a time when in the lead mines of the northern Pennines the costs incurred to buy coal to create steam were eating into the profits, and so a new power was tried and was found to be a great success. Any costs then came onto the pipework to contain the power source, but the source of this power was completely free. The source was only water - H_2O !

A very large part of the continuing success of the lead/zinc mines at Nenthead was due to the harnessing of water power by the Belgium Company called the Vieille Montagne Zinc Co. during the period between 1903 to 1915. Steam power had been used previously and hand drilling prior to blasting was still very much used. Although dry mechanical drilling had been introduced after 1898, this form was most used in the larger horse levels and for cutting cross cuts through barren rock. A certain stubbornness in the men led to a preference to the old method (hand drilling). There was in the area a reluctance to change, and it seemed easier to live and mine with the familiar than to learn new tricks of the trade that were not at first trusted ! In the first few years of mechanical dry drilling it was noted by many that their health seemed to be deteriorating rather quickly. Many wives and mothers quickly became widows and many children in the district lost their fathers and so there was no bread winner to bring home the wages. The realization came rather slowly that it was the breathing of the increased mining dust which came in great clouds from the mechanical drilling that was the cause. Eventually science came along with a drill that had water passing along the centre of the bit and this lay the dust and so thankfully "The Dying Days" were over and the widowmaker was consigned to history forever !

In the early days the compressed air for drilling came from plant that was sited in the old, now disused smelt mill and was powered initially by steam. By the start of the Great War, the steam plant was no longer used and replacement air was fed from a number of air compressors all of which were powered by water. I was privileged to know personally the last manager at Nenthead, Mr Amos Treloar, and he explained to me one afternoon at Maryport Docks just how this water power was utilized throughout the orefield. As well as air compressors, electrical generators were driven from water by the use of Pelton Wheels. This equipment came to be known as hydraulic compressors

and the power was fed (from two storage reservoirs that had been sited high on the hill above the town. The largest one, called Perry's Dam (NY 7855 4170), was 1,910' above sea-level, while the smaller, Smallclough Dam (NY 7875 4315) was lower at 1,546' in altitude. (See Figs 1 & 2 for all localities named in text.)

I will now try to explain the route that the falling waters took in order to place the power where it was needed in the mines, and from where the pipes containing the compressed air went after leaving the compressor houses. Water was directed from Perry's Dam in a large deep shaft not too far from the end of the dam, this shaft being called the Bog Shaft. This large diameter pipe charged with water went over the side of the shaft and down its side to the bottom, 349' below. The passage at its foot is called the Capelclough Horse Level, or more often Capelclough Low Level. On the way down, near the top entry, holes had been cut into the pipe and so, as this great force of water fell, it sucked in large quantities of air as well. At the foot of the shaft is sited a large receiver which separated out the air and water. The receiver is a metal flask standing about 20' high; the air, being lighter, goes up one pipe, while the water is forced via another pipe back up the shaft. At about halfway this turns into a higher passage called the Capelclough High Level and is then allowed to run away out to the daylight and by means of leats eventually goes to fall into Smallclough Dam.

The genius of this system is that the water still contained in the pipe going back up to half the height that it entered from, compresses the air by hydrostatic pressure in a direct ratio to its head at the reservoir from whence it came ! The air when used for drilling at 90lbs per square inch could be taken long distances to be used, by a system of pumping called the "Mammoth" system. This consisted of a kind of stand pipe set up in a flooded sump; air was bled in at the bottom of this pipe and on its passage up the pipe it drew a certain amount of the water up with it and so became a pump. Amos told me that this was only used, say, overnight when no other usage for the compressed air was required.

Meanwhile, back to Bog Shaft. A second feed of water went along the land surface in a most direct way, to the spot where Old Carr's Burn meets with the Middleclough Burn and at that spot still stands the skeleton of an Engine House. Inside was a Pelton Wheel that drove an air compressor (Fig. 3). The waste water that had done its work was not allowed to run into the nearby river, but was urged onwards along leats until it too falls into the Smallclough Dam. I believe that this air supply was used exclusively in the cutting of the long Middleclough Level that has its entrance near to this Engine

Figure 1


Wellhope Shaft
High Raise Vein
Wellgill Vein
Hagg Level
River Nent
Brownley Hills Level
Gin Foot Sump
Facobe Shaft
Rampgill Mine
Nent Force Level
Nenthead Village
Brewery Shaft
Smallclough Dam
Smallclough Mine
Hangingsleave Level
Middleclough Level
Capelclough Low Level
Capelclough High Level
Bullroom Flat
Elliot St
Small Clough Cross Vein
Old Carrs Burn meets Middleclough Burn
Bog Shaft
Perry's Dam
Longclough Vein

House. The Middleclough Level went through poor ground and it was soon realised that it had been started above all the ore bearing ground, so this level lost money. After this level was finished, a third water feed, brought overland, went in at the portal of the Middleclough Level and along these long passages until reaching the Longclough Vein. The pipe went down sumps and along levels as it ventured through the workings and at last came into Smallclough Mine not far from the Ballroom Flat. Here it followed the Smallclough Cross Vein up to the point where the Elliot String intercepts. A large Engine Chamber was made and cut out of the rock here, 20' below the passage on Elliot String.

Many weeks of work had gone into the making of this Engine Flat. When we climbed down into it, it was so neat and the bed for the engine stood there like some Mexican sacrificial table, but had never been used to compress air or even to hold an engine. In one corner was an 80' deep shaft that the used water would have fallen down had it ever got to work, but this never happened. It is said that the instigator of the scheme, Mr I.J. Fernau, left the mines to take up a post in America and so this part of his plan never came to fruition ! This chamber is one mile as the crow flies from the entrance to the Smallclough Mine and the water, had it fallen down this 80 footer, would have gurgled its way through Carr's Level, passing the Hangingshawe Level, then to fall once more into Rampgill Mine to be used there. The underground shaft called the Brewery Shaft at Rampgill is very cluttered up with water pipes all around its sides, the shaft is deep and is concrete lined all the way down. All these water pipes measure 12" in diameter and to give the water sufficient head a 90' high water tank was built on the surface above this shaft thus making its drop down to the water receiver at shaft bottom some 418' below. Water was sent from Smallclough Dam into the 90' high water tank, air is sucked in as the water falls, and at the base water and air separate as explained previously. In this case the water is sent back up at least 200' to give compression.

Near shaft bottom, still with whitewashed walls, stands an engine chamber complete with arched niches and workbenches, just as left in the 1950's. In here stands the 140 H.P. Pelton Wheel that powered an electric generator and an air compressor as well. A further water line fed an 80 H.P. Pelton Wheel to drive a smaller air compressor and in addition some piped water came down from places quite unknown to me and fell onto a large underground water wheel (Fig. 4). At this place the water was allowed quietly to slip away with no chance of being re-used in this mine, and so it ran away into the Nent Force Level for its five mile meander to come out to the day just beyond Alston Town ! Besides those uses that I have already described for the compressed air down in the depths of the mine, in later years any other

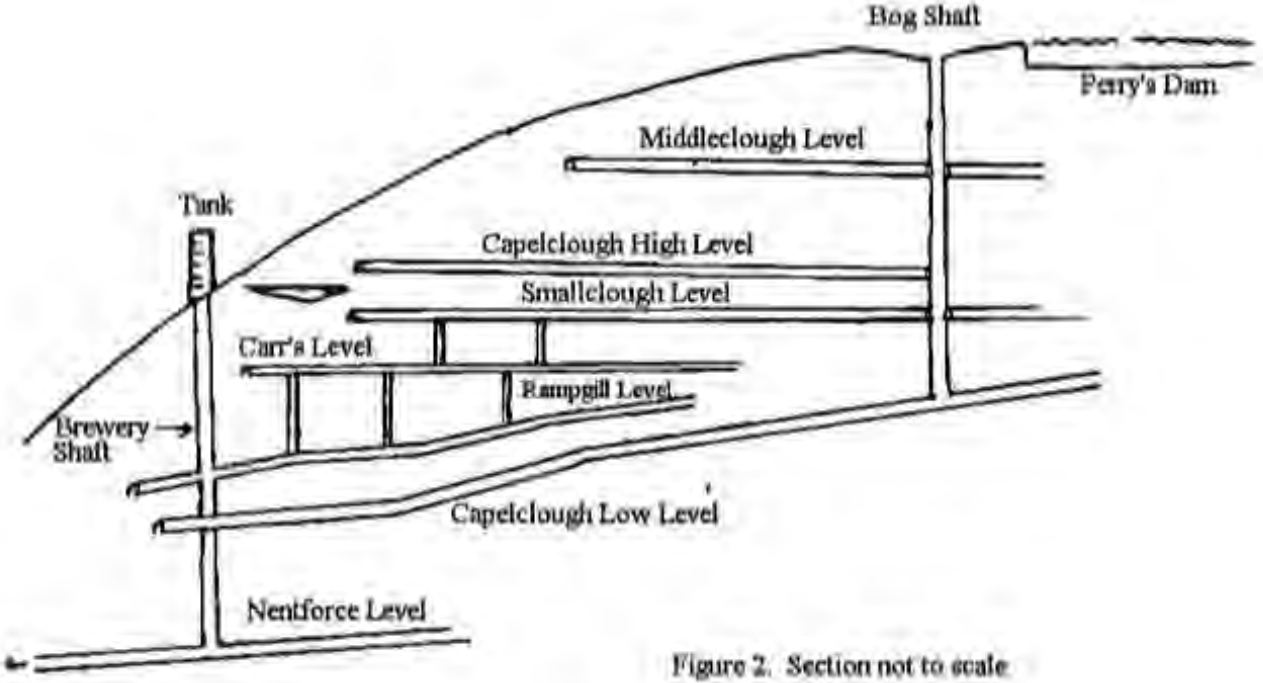


Figure 2. Section not to scale

projects tended to be further away from the original mine and air source. Thus it was that the Wellhope Shaft required air and this was away over the very high moor a long distance away. The men went underground to this place from the far end of Nenthberry Haggs Mine, but the distance was so great that the contents of the vein had gone from lead/zinc to barytes and some witherite ! This deep shaft and its vein system badly required a feed of compressed air so at first the line took a torturous route over the fields behind the village of Nenthead, then down a surface shaft called Jacobs, and along the workings in Brownley Hills High Level, then down again into the Brownley Hills Mine at its low level, then down its Gin Foot Sump, along the Wellgill Vein in Haggs Mine and so into the right turn that is on the High Raise Vein and so a long way on beyond the county boundary to the Wellhope system of veins. At one place along the Wellgill Vein an offshoot took air out to the Nenthbury Mill, but the rest travelled on for at least one and a half miles further. Whether it was because of leaks along the way or falls of roof causing damage, it became necessary to re-route the air line to Wellhope Shaft, and so in its final version the pipe went up the hill and across the moor in as short a way as possible, then down the side of the 400' deep shaft, and the earlier underground way fell out of use and was never pressurised again.

AUTHOR'S FOOTNOTE

The Brewery Shaft is actually down a short side passage that lies quite parallel with the main passage, but near enough to be approached from both sides. Any passages that are explored in this mine have to be waded through and it is often over knee deep. This water, so unavoidable in the mine, was allowed to run through to be used at the Brewery Shaft. This water has come from the far reaches of Smallcleugh Mine, seepage from the river at Force Vein at Carr's Level and a hundred other places higher up the hill.

Between Brewery Shaft and the main entrance passage is constructed a 3' deep sump with ends of water pipes and large air funnels set in one side. Just by lifting up a couple of short planks the water that flows past in the main passage can be channelled into the sump and then quickly flows away. In time of low water outside and in the dams on the moor above, this valuable flow could be switched from going out to the daylight and instead do a valuable job for the Nenthead system of mines ! I activated this system in about 1991 to see if it still could work, and was thrilled to see this sump start filling up, then water moved into the pipes and with a loud gulping sound those funnels into the pipes magically and steadily sucked in air with a loud sound powered only by this falling water. I doff my helmet to the old men's engineering skills.

Figure 3. Pelton Wheel (without casing) at bottom of Brewery Shaft (Photo by Granville Shillito).

Figure 4. Underground water wheel beyond Brewery Shaft (Photo by Granville Shillito).

CONSERVATION CORNER

Lancashire RIGS (Chris Arkwright)

In September, the first phase of site surveys was completed. This brought to a satisfactory conclusion almost five years work by many willing volunteers who have given their time freely. The 70 sites approved as RIGS have now been included in most Local District Plans and additionally have been ratified as County Geological Heritage Sites.

Sam Turner recently convened a meeting of Lancashire District Planning Officers, to explain the rationale behind the RIGS scheme. The importance of preserving examples of our own local geology was stressed. A description of the work carried out by the RIGS group was presented, together with an explanation of how these non-statutory sites are dealt with by the county and district planning systems. We already had the backing of Lancashire County Planning Department and now feel we have sympathetic support at district level also.

After a long period of consolidation and collection of details associated with Phase 1, it is time to look forward to the next stage. An appraisement of the RIGS now approved throughout the county revealed some gaps in the geographical and stratigraphical coverage of the area. It is proposed that, in Phase 2, sites are selected to fill these gaps and thus achieve a full representation of the geology of Lancashire. To this end the county has been divided into sections, each with its own co-ordinator whose job will be to suggest further sites and assist those who have volunteered to survey them. Meanwhile, RIGS in the first phase have been broadly categorised according to proposed future use, i.e. sites suitable for limited access only, those suitable for educational visits and those capable of full development as a public amenity. With the co-operation of the local council and landowner, one site in the latter group is to be used in a trial project with provision of sign boards and leaflets to describe the geological features of interest.

Also, the group has been asked to advise on which geological sections should be preserved when a large quarry near Clitheroe is eventually restored. This illustrates the fundamental role of a RIGS group, which is to encourage local geological conservation by negotiation and consultation. There is still plenty of work to be done and any offers of help would be much appreciated. Please contact Alistair Bowden at Clitheroe Museum on 01200 424568.

Greater Manchester RIGS (Simon Riley)

1996 was a quiet year on the RIGS front, with some progress being made on the site recording survey. However, this year there has been a marked increase in the number of volunteers keen to help with the site recording. We are now beginning to make considerable headway with this survey and may soon be moving on to the next stage in the RIGS process. In addition, we have been looking at glacial erratics in Manchester with a view to include them in the RIGS scheme. Assistance is always welcome. Please contact Simon Riley, The Manchester Museum, The University of Manchester, Oxford Road, Manchester M13 9PI (Tel. 0161 275 2636; Fax 0161 275 2676; e-mail simon.riley@man.ac.uk)

Staffordshire RIGS (Reproduced from Bulletins **39** & **40** of the North Staffordshire Group of the Geologists' Association.)

The RIGS Group have conducted sessions at Miry Quarry (Apedale), Gib Tor (Roaches) and Highshutt Quarry (Cheadle) to test the usability of RIGS assessment sheets. It is hoped that the adoption of these forms will standardise assessment criteria.

Ken Rout has visited the RIGS site at Barracks Lane Quarry, Hammerwich (c. SK 062 058) and his report indicates that the standard of exposure is not high. Access is poor and the site may have suffered from being used for dumping.

The land which contains the *Darwin's dyke* exposure at Hanchurch Hills (SK 840 400) has been confirmed as belonging to the estate of Lord Stafford.

The review by the Derbyshire Wildlife Trust of suggested RIGS sites in the Staffordshire part of the Peak District [see below - Ed.], as submitted by the SRIGS Group, has been completed. A listing of the assessment is available from Don Steward, SRIGS Data Manager, c/o City Museum, Stoke-on-Trent. Briefly, the Roaches area sites have been approved as grade A (good potential and landowner interest), whilst most of the rest are grades B and C (not such good potential).

Derbyshire RIGS (Leslie Noe & Pauline Jones)

Identification of RIGS sites. Since the initiation of the Derbyshire RIGS Project in 1991, just over 200 RIGS sites have been identified through literature searches and field reconnaissance. Of these 200 sites around half lie within the area administered by Derbyshire County Council, the remainder falling within the Peak National Park. Over the last 12 months effort has been concentrated on identifying geological features and formations which are poorly represented in the RIGS database. The Open University Geological Society has assisted with the field work, and with their help a number of sites in the Coal Measures have now been designated as RIGS. The Derbyshire Caving Association is

currently liaising with the Derbyshire RIGS Group to ensure RIGS status can be achieved for a number of key caves in the county.

Achieving conservation status for RIGS. Details of all RIGS sites have been lodged with the appropriate planning authorities, and are now given due consideration when planning applications are being processed. In the Derbyshire County Council area, RIGS sites and wildlife sites have been classified collectively as non-statutory "Sites of Importance for Nature Conservation", or SINCS, and thus conservation status should be assured.

Developing the educational potential of RIGS. During 1995-96 the Peak Park Joint Planning Board and English Nature contracted the Derbyshire Wildlife Trust to conduct a pilot conservation and educational project relating to RIGS sites within the Peak National Park. During this study all the RIGS sites in the Peak Park were assessed to establish their conservation and educational potential, and to determine likely conflict of interests between geological, ecological and archaeological conservation requirements of each site. Action plans for a number of sites, or groups of sites, have been drawn up and contain details of the geological/ecological/archaeological interest; an assessment of the educational potential of the site for specific target audiences; an assessment of the accessibility and health and safety issues pertaining to the site; details of conservation, development and interpretation work necessary to achieve the full educational potential of each site; and finally, a costing for implementation of the action plan, and the means by which it might be achieved. The educational potential of RIGS elsewhere in the county is being considered, and an "educational resource pack", centred on a group of RIGS sites in the Derby area, is currently being compiled.

MUSEUMS ROUNDUP

Clitheroe Castle Museum

Having spent two years in the hallowed world of the museum curator, I am beginning to understand why geologists are so well suited to this vocation. Many of the tasks, particularly those associated with collection management, are immensely time consuming. Being familiar with the concept of geological time helps to nurture a mentality in which goals are achieved over years rather than immediately.

The mineral collection of the Museum of Lancashire is a perfect example of this. Though some work had taken place before my arrival, it has taken just over two years to complete the cataloguing and storage of the 2,447 minerals. For many years, much of the work on this collection has been carried out by one dedicated volunteer, Norman Catlow, who comes to the museum once a week. This highlights the geologically slow way in which museum work progresses, somewhat reminiscent of gradualism in evolution.

The re-storage and documentation of the igneous rocks is now well under way and by next Christmas (note distant deadline), the sedimentary and metamorphic rocks should also be completed. The fossil collection, both the most numerous, poorly documented, poorly stored and most notoriously difficult section to categorise, will be dealt with in early 1998 (what fun awaits).

Whilst all this collection management work has been carried out, other projects have also been developed. Early last year a room was vacated allowing us to begin work on an education facility. This began as a minor aside, producing a number of activities for primary school groups to use unaided and has now blossomed into the "Earth Science Handling Session". It is made up of three phases: before arrival, a school is sent suggested pre-course exercises, to introduce some of the basic concepts such as geological materials in everyday life and fossilisation. The activities at the museum involve real specimens and concentrate on materials and their differences as well as fossil plaster-cast making and a gold panning exercise. The post-course pack aims to consolidate some concepts dealt with at the museum, and also introduces plate tectonics (in a very simple form) to conclude the exercises. The latter pack includes real specimens and forms a loan box administered by Lancashire Museum Service to Schools (which offers delivery and removal of items to schools).

The most popular event of the past year was the activity weekend held in July. A variety of volunteers gave up their weekend to run a number of hands-on activities, special displays, tours, quizzes and children's events. Military history, social history, spinning, Victorian washing day, printing, natural history, fossil bran tub, coral sectioning and gold panning were but a few of the topics on offer. This was the museum's busiest weekend of the year, and it is hoped that a similar event will be run again this summer.

The re-occurring problem associated with only having one pair of hands will continue to make each task take an inordinate amount of time, with only one person to attempt to complete everything. I conclude with the thought that the world would be a more productive place if one or two of the "freak" creatures from the Burgess Shale fauna had given rise to a race, rational like ourselves, but with many limbs and lots of eyes, allowing it to carry out routine cataloguing tasks whilst fulfilling the more complex and demanding jobs at the same time !

(Alistair Bowden)

LGA FIELD TRIP TO BOULBY POTASH MINE (18th JULY 1996)

Leader: Peter Edey

On a glorious mid-summers day, a select group attended a field meeting eight kilometres out to sea off the coast of North Yorkshire.

The excursion into the Boulby Potash Mine was conducted by mine geologist Peter Edey, and entailed a descent of the main shaft to depth of 1150 metres followed by an 8km drive in an open topped truck in pitch darkness through the excavated roadways of the mine to the most northwestern working face. The temperature here, due to the depth of workings, is 32°C. At the southern face which is inland, the temperature is higher at 42°C because of the insulating effect of the overlying strata.

The Boulby mine exploits a typical marine evaporite deposit of Zechstein age. Lying above the Upper Magnesian Limestone, some 40m of halite are overlain by varying thicknesses of potassium and magnesian chlorides. These beds have an overall dip of about 1:30 to the south-south-east and form the western edge of the late Permian Zechstein Basin. The same deposits are exploited extensively in the eastern parts of the same basin in Germany and Poland.

All of the access roadways in the mine are driven in the massive halite layer because of its relative stability compared with the potash layer, which is more prone to flow under pressure. Even so, the roads are under intense lithostatic pressure because of the depth of the workings, and this has to be accommodated by provision of slots which are cut into the sides of the roadway to relive stress. Several of these were seen in various stages of deformation.

The mobility of the potash minerals under pressure is held to account for most of the variability of the deposits both in thickness (from nil to almost 30m thick) and in concentration (from only a few percent to greater than 60 percent potassium chloride). For this reason, exploratory drillings are made horizontally from the ends of the bays in the halite roadways; the drills are directed to curve upwards into the potash layer and extract cores, which can then be used to determine the optimum direction for the mining to proceed.

Once a heading has been determined in this way, a ramp is excavated upwards into the ore stratum to allow access of the mining machinery.

The potash is worked in parallel roadways called "panels", separated by

narrow pillars. The ore is extracted from the panels using continuous mining machines which remove up to 300 tons per hour. This is moved by shuttle-trucks and conveyer belt to the main shaft, where it is hoisted to the surface in 20 ton skips. The voids from which ore has been extracted are then allowed to collapse progressively as the pillars slowly give way under pressure from the overburden.

The mine was in full production during the visit so that our members were able to experience at first hand the working conditions for the miners here at the ore-face. When the extraction machinery is in action, the noise is deafening. Dust fills the air so that the working lights are dimmed to a pale glow. The taste of salt penetrates the dust-masks which everyone wears and the heat seems even more oppressive. The eyes are pricked by salt particles.

At close quarters, the potash deposits could be seen to take the form of an intimate mixture of pale, watery halite with reddish haematite-stained sylvite crystals. Evidence for the mobility of the potash minerals under pressure was clearly seen in the working faces, where complex flow structures were visible everywhere.

The primary ore at Boulby is a variable mixture of sylvite (KCl) and halite (NaCl) known as "Sylvinite". This is processed after extraction to separate out the potassium salt by crystallisation. In some areas of the mine, carnallite ($KCl.MgCl_2.6H_2O$) is present and is also mined. At Boulby Mine, Cleveland Potash produces in excess of 800,000 tonnes per annum of potassium chloride for the fertiliser industry and in addition some 300,000 tonnes of sodium chloride are produced as a secondary product for use on the roads.

Specimens of the above minerals were later demonstrated in a small sample collection in the mine geological laboratory, as were also examples of anhydrite ($CaSO_4$) from the base of the evaporite cycle, dolomite ($CaMg(CO_3)_2$), gypsum ($CaSO_4.2H_2O$) and boracite ($Mg_3B_7O_{13}Cl$). This last mineral is troublesome in the mining process because it typically occurs within the sylvite layer in the form of large nodules up to one metre in diameter. The extreme hardness (8 on the Moh's scale of hardness) of the boracite in these nodules causes problems with the tungsten carbide cutting teeth and drill bits.

After some two hours spent beneath the North Sea, the party resurfaced, dry and a little salty, to a welcome cup of tea. After an informative question-and-answer session with Mr Edey, the group left for home taking with them the memory of a unique experience, a small sample of boracite and a lingering taste of salt.

Acknowledgement is due to Mr Holmes and Mr Edey of the Geological Department and to Cleveland Potash Ltd, for making this visit possible.

Suggested reading

HOLMES, R. (1991). Some aspects of the geology of the potash seam at Boulby Mine. *Journal of the Open University Geological Society*, **12**, 77-88.

GREEN, D.I. & FREIER, M.D. (1996). The Boulby Mine. *The Mineralogical Record*, **27**, 163-170.

WOOD, P.J.E. & POWELL, P.J. (1979). The geology of Boulby Mine. *Economic Geology*, **74**, 409-418.

(Norman Catlow)

LGA FIELD TRIP TO THE VALE OF CHIPPING (11TH MAY 1996)

Leader: Mike Gosling

On the 11th May 1996 members of the LGA assembled at the Visitors' Centre on Beacon Fell, where the excursion leader Mike Gosling gave a summary description of the day's itinerary. The aim was to examine the geology of the Vale of Chipping at a number of locations where weathering of the Thornley Anticline has exposed Lower Carboniferous rocks of Chadian to Brigantian age.

Locality 1 - Blacksticks Farm (SD 592423)

An outcrop of the Lower Bowland Shales was examined in an exposure close to the road at Blacksticks Farm. Here, the north-western limb of the Blacksticks anticline is seen in a thin-bedded, black, laminated mudstone with variable, generally northerly dip. The exposed beds show evidence of flexural slip-folding, with slickensided bedding planes.

Fossils identified by the group included bryozoans, goniatites, brachiopods, bivalves and algal nodules.

Locality 2 - Arbour Quarry (SD 620407)

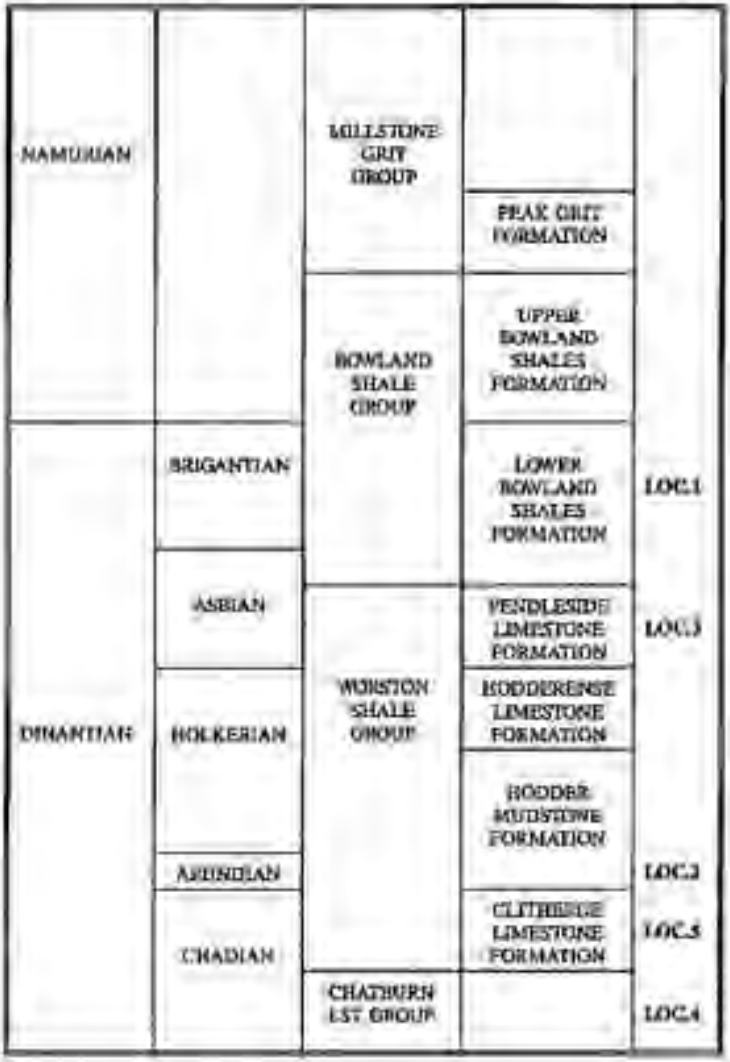
Along the south face of the quarry at this location, the group examined an interesting outcrop of Limekiln Wood Limestones of the Worston Shale Group.

The outcrop here consists of unsorted, rounded boulders of Waulsortian limestone set in a shaly mudstone, and was described as being one of the best examples of a boulder bed in the Craven Basin. The mudstone has weathered back between the clasts, revealing their rounded shape and random orientation.

Mike Gosling explained these boulder beds as having been formed on the basin floor of late Chadian times, by submarine landslips which occurred during extensional horst and graben formation.

Locality 3 - Stakes (SD 646437)

In the bed of the River Hodder at Stakes, outcrops of the Pendleside Limestone were examined. The dip of the strata here was vertical to sub-vertical, close to the core of the Thornley Anticline. Several instances of


NAMURIAN
MILLSTONE GRIT GROUP
PEAK GRIT FORMATION
BOWLAND SHALE GROUP
UPPER BOWLAND SHALES FORMATION
LOWER BOWLAND SHALES FORMATION
LOC.1
BRIGANTIAN
ASBIAN
PENDLESIDE LIMESTONE FORMATION
LOC.3
WORSTON SHALE GROUP
DINANTIAN
HOLKERIAN
RODDERENSE LIMESTONE FORMATION
RODDER MUDSTONE FORMATION
ARUNDIAN
LOC.2
CLITHEROE LIMESTONE FORMATION
LOC.5
CHADIAN
CHATBURN EST GROUP
LOC.4

slump-folding in the limestone were apparent, and instances of marked cleavage were pointed out. One prominent example featured obvious cleavage which affected both the limestone and a major chert inclusion.

Locality 4 - Whitewell Gorge (SD 655465)

The oldest Dinantian rocks exposed in the district were seen at outcrop in the core of the Thornley Anticline here, by the roadside above the River Hodder. They consisted of thin, to medium-bedded, fine-grained, grey limestones of the Chatburn Limestone Group. Occasional fossils, mainly fragmentary, could be found. Among those recognised were solitary corals, crinoids and brachiopods.

Evidence of past landslips in the sides of the gorge was demonstrated, in the random variability of the dip and strike features along the outcrop.

Locality 5 - Hall Hill Quarry (SD 668466)

The final exposure examined by the group was in the limestone quarry at Hall Hill. Here, quarrying has revealed a complete cross section of a classic Waulsortian mudmound.

Observation of the contact between the base of the mudmound and the underlying stratified limestone was used to demonstrate the diachronous nature of the growth of the mound. (This is one of very few examples where the base of the mound is visible.)

A close search of the quarry face revealed it to be highly fossiliferous, with abundant crinoid debris. Many good examples of stromatactis cavities were found, and a lively discussion on their possible mode of origin followed.

Finally, the group moved to the top of Hall Hill above the quarry, for a view back down the Vale of Chipping. The starting point of the excursion on Beacon Fell could be seen in the distance at the head of the limestone- floored valley which currently occupies the crest of the Thornley Anticline. On either side, the gritstone ridges of Longridge Fell and the Bowland Forest hills formed the flanks of the valley and of the anticline. The Vale of Chipping forms a perfect textbook example of inverted topography.

(Alistair Bowden)

BOOK REVIEWS

Agate microstructure and possible origin. Terry Moxon. 1996. Terra Publications. ISBN 0 9528512 0 2. Paperback £6.90, 106pp.

Agates with their unusual and delicate patterns are among the most fascinating forms of microcrystalline quartz. They have been collected for centuries and are commonly used in jewellery and art. It seems surprising, therefore, that relatively little is published on the mechanism of agate formation. Professional scientific papers dealing with agate and agate genesis are widely scattered through the literature, many of the early works are in German, while more recent research may be published in chemical, physical or mineralogical journals.

Terry Moxon has made a lifetime study of agate and *Agate microstructure and possible origin* is one of the results. It begins with a short description of some of the agate localities in the Midland Valley of Scotland, although it does not set out to be a topographical guide. The remaining chapters are more scientifically inclined, and show what an amateur scientist (in the best sense of that term) with a strong interest in a particular field can accomplish. Chapter two describes the preparation of sections for microscopic analysis and is written with the geologist or microscopist working at home in mind.

The microstructure, colour and banding of agates are then discussed in three chapters which take the reader a little over halfway through the book. Each provides a stimulating account of the techniques involved and a careful interpretation of results. The remaining chapters (six to nine) deal with agate genesis, summarising previous research in the field, together with the author's own views. Several different theories are discussed and the shortcomings of each outlined. The author makes it clear that while theories of agate genesis have advanced considerably since the turn of the century, there are still many questions left unanswered.

I found *Agate microstructure and possible origin* a stimulating book and have no hesitation in recommending it. It is a shame that more scientists in Terry's position do not take up the challenge of writing.

(David Green)

The structure and evolution of the Northumberland-Solway Basin and adjacent areas. R.A. Chadwick, D.W. Holliday, S. Holloway & A.G. Hulbert. 1995. Subsurface memoir of the British Geological Survey. ISBN 0 11 884501 2. Paperback £35, 90pp.

For anyone interested in the Carboniferous of Northern England, this new subsurface memoir is a must. This may seem a somewhat rash statement when considering the hefty price-tag, but read on and you will see why.

This book is an integrated, multidisciplinary basin history of the Northumberland Trough. Much of the surface information is derived from previous sources, and thus in many respects this is a review. However the subsurface data is largely unpublished. It is this 3-dimensional view of the basin geometry, and detailed imagery of the sediment package which creates the need for a truly regional perspective.

The text is clearly written and concise, but the mass of detailed 3-D information is conveyed using a variety of well-interpreted figures. The memoir begins with an introduction to the region, a summary of previous research and an outline of the geological history. This section includes topographic, geological and structural maps, and also theoretical oblique air views of the top of the Caledonian basement.

The first chapter deals with the largely concealed Lower Palaeozoic basement. The Lake District-Alston and Southern Uplands Blocks, their junction along the Iapetus Convergence Zone and the influence of basement structure on basin development are discussed.

The following chapters describe the late Devonian-early Carboniferous synextensional and late Dinantian-Silesian postextensional phases of basin development, Variscan basin inversion and post-Variscan events. Each chapter takes a stratigraphic and regional view of a phase in the basin evolution. This is clearly illustrated using seismic reflection profiles, borehole logs and maps showing palaeoenvironmental reconstructions. The latter are the most exciting and revolutionary innovation in this publication. Normal memoirs, papers and theses cover a limited area or stratigraphic horizon. However, the integration of almost two hundred years work on the Northumberland Trough has produced a description of the "what, where and when". This regional synthesis is an invaluable tool to anyone with a remote interest in the stratigraphy of Northern England.

The final chapter summarises the economic geology of the basin. This

has been and will continue to be an important basin for its mineral wealth, including coal, hydrocarbons, coal-bed methane, geothermal energy, underground storage/disposal of fluids, evaporites and ore minerals.

The final section contains an extensive reference list, details of Geological Survey material covering the area, generalised borehole information and a series of contour maps. These show structural features and contours depicting the base and thickness of each major stratigraphic unit. It is these diagrams that show details of the new subsurface data and underpin much of the new interpretation of the basin evolution.

To summarise, this is a true gem (not a phrase I often use to describe hardcore geological texts). It interprets a vast array of complex geological information and presents it in an easily understood format. I hope the Geological Survey are planning to produce more subsurface memoirs; this is a very important niche in the geological literature which only they can supply.

(Alistair Bowden)

Geology of Connemara. J.H. Morris, C.B. Long, B. McConnell & J.B. Archer. (Eds J.H. Morris & C.V. MacDermot). 1995. Geological Survey of Ireland. ISBN 0 9515006 7 8. Map & report £12.50, 66pp.

Geology of North Mayo. C.B. Long, C.V. MacDermot, J.H. Morris, A.G. Sleeman, D. Tietzsch-Tyler, C.R. Aldwell, P. Daly, A.M. Flegg, P.M. McArdle & W.P. Warren. (Ed. A.G. Sleeman). 1992. Geological Survey of Ireland. ISBN 0 9515006 1 9. Map & report £12.50, 50pp.

The Geological Survey of Ireland is proceeding with its publication of the 1:100,000 Geological map series, each map accompanied by an explanatory booklet describing the geology of the area mapped. The whole series, comprising 25 sheets, is intended to cover the bedrock geology of the island over the next four years.

Among the first issues to become available are Sheet 6 (North Mayo) and Sheet 10 (Connemara).

The map sheets are clear and easily legible, with unobscured topographic details and easily referenced geological data. Each main sheet also features small inset maps and tables which summarise the stratigraphic succession in defined sub-areas of the sheet. The system of cross referencing allows

straightforward access to the wealth of information, making the maps a pleasure to use.

The explanatory booklets which accompany the sheets are aimed in particular at the interested amateur, and feature comprehensive glossaries of geological terms and a full list of relevant publications. The geological evolution of the mapped areas is described in lucid detail, and abundantly illustrated with sketch maps, diagrams and photographs. Both booklets include descriptive sections on the distribution of economic minerals and their exploitation, and the Mayo booklet also has an appendix which summarises briefly the plate tectonics, and rock-forming processes involved in the geological history of the region.

The style of both presentations is attractive and is aimed to provoke the interest of all with an interest in geology and the landscape, while the wealth of detailed information included will make them invaluable to the professional geologist.

The publications are attractively presented, with colourful bindings, and come complete with map, in a transparent plastic folder. What is more, they are very reasonably priced.

Both of these publications can be obtained from:
The Geological Survey of Ireland, Beggars Bush, Haddington Road, Dublin 4, Ireland.

(Norman Catlow)

THE 1815 MAP OF WILLIAM SMITH

- THE FATHER OF ENGLISH GEOLOGY

A valuable teaching resource for earth science students at all levels

The production of the first national geological map of England and Wales, with parts of southern Scotland, was undoubtedly a milestone in geological history. However, this achievement is not always appreciated by students of geology because few copies of the original map have survived to the present day.

Liverpool Geological Society is proud to own one of the few surviving copies of the map. In order that more geologists may enjoy and appreciate the major contribution made by William Smith, LGS has reproduced this map in poster form. The map is relevant to the teaching of developments in stratigraphy, mapping and history.

It is available for sale at meetings of Liverpool Geological Society, Manchester Geological Association and the Geologists' Association in London. It may also be purchased by post (£10 which includes post & packing) from the British Geological Survey, Keyworth, Nottingham NG12 5GG.

PROCEEDINGS OF THE LIVERPOOL GEOLOGICAL SOCIETY

1995/96 SESSION

1995

Sep. 24 Field trip to The Cliviger Gorge led by Hazel Clark.

Oct. 10 The Presidential Address by Chris Hunt – *The Geology of Iceland.*

Oct. 24 Field trip to Winsford Salt Works and mine visit.

Oct. 31 The Distinguished Member's Address by Professor Trevor Elliot *Sequence stratigraphy: a new look at the stratigraphic record.*

Nov. 18 Practical Session at Liverpool Museum with Wendy Simkiss and Tony Morgan.

Nov. 21 *Geological highlights of Alaska and the Yukon* by Tony Waltham.

Dec. 5 *The geological story of the Lake District* by Tom Shipp (followed by Cheese & Wine).

1996

Jan. 16 *How astronomy may have a major impact on geology* by Peter Smith.

Jan. 30 Practical Session at Liverpool John Moores University on *Oil and gas exploration* with Joe Crossley.

Feb. 6 *Graptolites* by Charlie Underwood.

Feb. 9 The Society Dinner at Jenny's Seafood Restaurant, Liverpool.

Feb. 17 Herdman Earth Sciences Symposium on *Sea level changes.*

Feb. 20 *Ancient climes: cold times and places in a greenhouse Earth* / by Jim Marshall.

Mar. 3 Field trip to Thurstaston led by Mike Hambrey.

Mar. 12 *An overview of Mongolian geology* by Dr Tumen Bayar (introduced by Robin Grayson).

Mar. 19 *The formation of the Dover Strait* by Phil Gibbard.

Mar. 29/31 Field trip to Anglesey led by Arnold Jones and Joe Crossley.

May 18 Field trip to Goyts Moss via Burbage led by Michael Eagar (joint trip with the MGA).

Jun. 2 Field trip to Ingleborough karst and caves led by Frank Nicholson.

Jun. 16 Field trip to the Quaternary geology of Borrowdale led by Alan Smith (joint trip with the Cumberland Geological Society).

Officers and Members of Council for the Session 1995/6 and Trustees 1995/98:

President - N.C. Hunt BEd
Ex-President - H. Davies MA
Vice-President - Miss H.E. Clark MSc
Hon. Secretary - J.D. Crossley BSc, CertEd, CGeol, FGS
Hon. Asst. Secretary - S. Bowie
Hon. Treasurer - G.W. Rowland MIMBM
Hon. Asst. Treasurer - W. Simkiss BA
Hon. Editor (Geol. Journal) - C. Milsom BSc, PhD
Hon. Editors (N.W. Geologist) - N.C. Hunt BEd; R.C. Wright MA, PhD
Hon. Librarian - Mrs L. Rimmer CChem, MRSA
Hon. Excursion Secretary - T. Metcalfe BA
Hon. Treasurer Special Issues Fund - G.G. Harden LDS
Hon. Archivist - P.W. Phillips BSc, AMA

Council - R. Bell
L. Bryan
H. Delaney
R. Fleming
S. Gonzalez BEng, MSc, PhD
C.J. Kerley BSc
P. Leicester
A. Morgan
R.J. Ousby BA
P. Parsons MSc

Trustees - Professor D. Flinn, Professor W.S. Pitcher, J.K. Shanklin BSc, CGeol.

Membership on 30 September 1996:

190 Ordinary members, 37 Student members, 6 Honorary members, 3 Life members. Total = 236 (same as last session).

The Liverpool Geological Society Prizes for General Excellence were awarded as follows:

The University of Liverpool - Geology: Katherine Jane Bond
- Geophysics: Daniel Sayer & Nigel Seymour
- Geology & Physical Geography: David G. Cliffe & Daniel J. Herron.

Liverpool John Moores University - Earth Science: Peter Lyon

PROCEEDINGS OF THE MANCHESTER GEOLOGICAL ASSOCIATION 1995/96 SESSION

1995

Apr. 29	Annual Dinner at Harwood Rooms, UMIST. Guest of Honour: Mr Velson Horie.
May 14	Field trip to Ingleton led by John Varker.
Jun. 17	Field trip to Monsal Dale and Monyash led by Trevor Ford.
Jul. 9	Field trip to Snowdonia led by Malcolm Howells.
Aug. 12	Field trip to Swaledale led by Sallie Bassham.
Sep. 3	Field trip to Borrowdale led by Alan Smith.
Sep. 20	*Conversazione* at The Manchester Museum.
Sep. 24	Field trip to the White Peak led by Cynthia Burek.
Oct. 11	*Exploring early land vegetation* by Professor D. Edwards.
Nov. 8	*On the emergence of life at submarine hot springs* by Professor M. Russell.
Dec. 13	*William Smith - his life and work* by Dr H. S. Torrens.

1996

Jan. 10	*Magmatism along the Antarctic Peninsula* by Dr C. Wareham.
Feb. 14	Annual General Meeting and Presidential Address by Dr John Nudds - *Dinosaurs !*
Mar. 13	*Granite* by Dr M. Atherton.

Officers and Members of Council for the Session 1995/6

President - John R Nudds BSc PhD FGS CGeol
Vice-Presidents - Richard Pattrick BSc PhD; Fred Marriott FRCS
Hon. Secretary - Norma Rothwell BSc
Hon. Treasurer - Tony Browne BA
Hon. Editors (Geol. Journal) - R.M.T. Eagar MA, PhD, DSc; A.F. Adams BA, PhD
Hon. Editors (N.W. Geologist) - J.R. Nudds PhD; Sheila Owen BA
Hon. Librarian - M. Ellsworth
Hon. Indoor Meetings Secretary - C.G. Allen MSc
Hon. Field Excursion Secretary - J. Spencer BSc
Hon. Auditor - E. Foster MA
Council - Christine Arkwright BA
R. Clarkson
Mary Howie BA
Joyce Little
A.J. Scott BSc, PhD
Betty Whitehead BSc
President of the University of Manchester Geological Society

PROCEEDINGS OF THE LANCASHIRE

GEOLOGISTS' ASSOCIATION 1995/96 SESSION

1995

Apr. 23 Field trip to Horr Gorge & Alum Scar RIGS sites led by members.

May 14 Field trip to Murton Fell, Cumbria led by Dr R. Wright.

Jun. 17 Field trip to Pendle Coalfield led by I. Williamson & H. Clarkson.

Jul. 15/16 Field trip to Whitby coast by led by P. Manning & P. del Strother.

Aug. 19/20 Field trip to Frodingham Ironstones and Scunthorpe Museum led by S. Thompson.

Sep. 20 *The Late Devensian in the Fylde* by Dr D. Longworth.

Oct. 27 *The Geology of the Fylde Coast Sewage Pipeline* by L. Duffy.

Nov. 24 *Carbonate, basalt and rhyolite lava flows* by Dr H. Pinkerton.

1996

Jan. 12 Annual Dinner and AGM.

Jan. 26 *The Geology of Mull* by Dr R. Wright.

Feb. 23 *Britain's Rocky Scenery* by I. Williamson.

Mar. 29 *The Geology of Nuclear Waste Disposal* by Dr R. Chaplow.

Officers and Committee Members for the Session 1995/6.

Chairman - Mr P. del Strother
Vice Chairman - Mr J. Slopforth
Secretary - Mr T. Lund
Treasurer - Mr A. Gunr
Editor(Newsletter) - Mrs J. Rhodes
Librarian - Mr J. Savin
Field Secretary - Mr N. Catlow
Committee Members - R. Clarkson
Mr D. Learoyd
Mr I. Williamson
Mr J. McNeal

Correction. [illegible] North West Geologists [illegible] Group of the [illegible] Geologists' Association [illegible]

Alistair's fault! Tut Tut

[illegible] [illegible]

[illegible]

Two new members –

Mr N W Taylor 15? West Park Av Ashton-upon-Ribble PR2 1??

Ms J Swaggs 72 Church Rd St Annes FY8 3?3