Farnham Geological Society

(A Local Group within the Geologists' Association)

NEWSLETTER AUTUMN 1996

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Nineteen members of our Society returned to Britain on 13 July after the trip of a lifetime to the USA. There were most extra participants both from this country and North America so that we had a comfortable coachful. We owe a great debt of gratitude to John and Lyn Linse and Peter Luckham who organised it from this side but above all to Ivan Dyreng of Salt Lake City, Utah. Ivan arranged all the bookings and was our guide, philosopher and friend for the whole trip. The tour was actually in two parts, firstly 'The Yellowstone Dinosaur Tour' and secondly 'The Canyon Spectacular Tour' with two days to recuperate in Salt Lake City in-between.

Since our return we have been treated to a reunion on 18 August at the Brash's at which slides were shown. At our usual Friday lecture on 13 September at the Central Club five people showed their slides illustrating various aspects of the trip. Furthermore the Society gave an excellent display at the Annual Reunion of the Geologists' Association at University College, London, on 2 November. The centre-piece was a collection of fish fossils from Ulrich's Fossil Quarry in Wyoming, the most spectacular being a find of John Linse that the quarry owner was reluctant to let him have. Ulrich was unaware of John's powers of persuasion! There will be a full report of our USA trip in a later Newsletter.

Meanwhile we are greatly obliged to Roger Ashcroft for his polished and comprehensive report on our Shropshire Field Trip of 1995 and to his wife Wendy who did the word-processing and made such corrections as were necessary. The Shropshire trip coincided with the 25th anniversary of the founding of our Society. The USA trip had been postponed to 1996 because of the difficulty in getting the travel arrangements fixed in time.

Finally we must thank Cath Clemesha for a useful article on chemistry as applied to geology for the benefit of those whose days of studying 'stinks' are long past.

At our Annual Dinner on 25 October we were sorry to hear that Ivan Dyreng had suffered a heart attack. We all wish him a speedy recovery.

ROCKY ROADSHOW

The Farnham Geological Society was invited this summer to provide a display at the Haslemere Museum in aid of the **Rocky Roadshow** organised by **Rockwatch.** The aim of Rockwatch is to show what rocks, minerals and fossils may be collected in the area, which societies could be helpful and to encourage children to examine specimens 'hands on.

Accordingly on Saturday, 27 July, five members of our Society assembled at the Haslemere Museum at 10AM with a varied collection of specimens. Fossils predominated as these make the most impact with the young. David and Shirley Stephens had a collection together with books and pamphlets illustrating them. Visitors would be encouraged to identify specimens and if successful would be eligible for a prize provided by the Newsletter editor from his collection of fossils, polished stones, etc. Cath Clemesha and Peter Cotton also brought interesting contributions, the emphasis beingthat children should handle them. The Lamdin-Whymark brothers had an excellent display from IOW.

Many others also brought specimens. Andrew Borland of Woking had superb mineral groups. Jane Armer, a museum volunteer, provided equipment for making fossil casts in plaster which children were quick to appreciate. John Betterton of Crowthorne had micromounts and a microscope to view them with while Dr Eric Robinson the librarian of the Geologists' Association brought a collection of books and leaflets dealing with GA activities. Our Society also put up a leaflet of our Aims and Activities but sadly no new members joined as a result.

Chris Andrew the Assistant Curator of Haslemere Museum rendered invaluable service in helping us to set up our various displays and , of course, we owe a debt of gratitude to Mrs Diana Hawkes the Curator for her hospitality in organising the show.

Some 60 visitors attended but as the show went on until 4 pm we were never overcrowded. We formed the impression that children much preferred to be doing things rather than just looking. There will be a repeat of the Rocky Roadshow in two years time.

There was an article and pictures in the *Haslemere Herald* of 2 August dealing with the day's events.

David Caddy

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CHEMISTRY IN GEOLOGY

Over the years quite a few members have said to me that my knowledge of Chemistry must have helped me with understanding Geology. Well some of it does, especially familiarity with the Periodic Table of the Elements and its significance. This is to me particularly relevant to the subject of acid and basic rocks.

I have compiled a few thoughts on this and also Oxidation and Reduction. Hopefully my ideas will help to clear some of the fog. For many members my explanation will be oversimplified and general, so if I have made any mistakes please tell me.

ACID AND BASIC ROCKS

Broadly speaking acid igneous rocks are rich in silica and basic rocks are less rich in silica and richer in ferro-magnesian minerals. **Silica** is silicon dioxide. **Silicon** is a non-metallic element. Non-metal oxides if they react with water form acids (solutions with a pH of less than 7). The commonest **acidic oxides** met in geology are silicon dioxide, carbon dioxide and sulphur dioxide.

Iron and magnesium are metallic elements (!). Metal oxides are called **basic oxides.** Some of them react with water to form alkalis (solutions with a pH of more than 7). **Alkalis** are soluble bases. Magnesium oxide does form an alkali, iron oxide does not. The strongest alkalis are formed by potassium and sodium (pH 14) in **Group 1.** Group 1 metals are known as **Alkali Metals.** Calcium and magnesium are in **Group 2** known as **Alkaline Earth Metals.** Their alkalis are weaker (pH 10-12). Barium and strontium are also in Group 2 and form alkalis. **Feldspars** are important compounds of potassium, sodium and calcium. **Orthoclase** (potassium aluminium-silicate) is an example of an alkali feldspar. Sodium and calcium alumininium-silicates are **plagioclases.** Together they make up about ⅓ of the earth's crust.

The basic oxides which do not form alkalis will react with acids to form **salts.** All minerals except oxides are salts: e.g. halite, sodium chloride; fluorite, calcium fluoride; barite, barium sulphate; malachite, copper carbonate.

Important **ferro-magnesian minerals** include olivine, pyroxene; e.g. augite, amphibole (hornblende), and biotite mica.

Aluminium is a very important metal in rocks and minerals. It forms an AMPHOTERIC oxide that can behave as an acid and form salts such as alumino-silicates in feldspars, micas and zeolites; and as a base and form aluminium compounds, for example aluminium oxide (alumina, ruby, corundum, sapphire, bauxite) and aluminium silicate (kyanite, sillimanite and andalucsite).

SOLUBILITY

Aluminium oxide in mildly acid ground water (pH 5-6) is virtually insoluble so it remains after other minerals have weathered out as bauxite or kaolinite. In more acid conditions (rotting vegetation or acid rain) it is more soluble and is leached downwards to become incorporated in clays.

Most potassium and sodium compounds are very soluble in water and will be the first to be dissolved out in weathering. On the other hand calcium compounds are only slightly soluble so calcium carbonate and calcium sulphate are the first evaporite minerals to appear when sea water evaporates (calcite and gypsum).

RELATIVE ABUNDANCES OF ELEMENTS

The relative abundances of the elements (as Oxides) we have been dealing with expressed as percent in granite and basalt are as follows:

	Granite	**Basalt**
Silicon	70.8	49.0
Aluminium	14.6	18.2
Iron	3.4	9.2
Calcium	2.0	11.2
Magnesium	0.9	7.6
Sodium	3.5	2.6
Potassium	4.6	0.9
+	0.2	1.3
	100	100

This analysis shows the reduction of silica in basic rocks; the presence of more potassium and sodium feldspars in acidic rocks and calcic plagioclase is basic rocks; and the increase in percent of iron and magnesium in basic rocks.

OXIDATION AND REDUCTION

We come across these terms in connection with the conditions under which rocks are laid down or weathered under water or in the air.

In the simplest terms, oxygen and hydrogen are considered to be opposites.

Oxidation is explained as the gain of oxygen or loss of hydrogen by a substance. Examples are rusting of iron to form **iron oxide** and hydrogen sulphide reacting with iron salts to form **iron sulphide** (pyrite).

Reduction therefore is explained as the loss of oxygen or gain of hydrogen by a substance, e.g. smelting of oxide ores of metals to form the metals.

These definitions do not cover all examples so another definition is used concerning the change in the number of electrons a metal uses in forming compounds. An increase in the number used is oxidation, e.g. iron uses two electrons in **ferrous** (iron II) compounds and three in **ferric** (iron III) compounds.

Oxidation and reduction cannot be separated. An oxidising agent oxidises a substance and itself reduced.

R (iron ore → iron)

e.g. iron ore (oxide) + carbon (coke) → iron + carbon monoxide

O (carbon → carbon monoxide)

Iron is a useful example because of its two OXIDATION STATES. It is one of the TRANSITION metals in the middle of the Periodic Table. They all have more than one oxidation state and most have different coloured compounds. Iron II compounds are often coloured green: e.g. olivine and epidote; iron III compounds are often reddish-brown, e.g haematite. Other transition metals common in geology are manganese II, III, and IV e.g. rhodochrosite (rose pink) and copper I, red as in cuprite and II, green or blue as in malachite and azurite. Unfortunately one cannot generalise about the colour of a mineral due to its metal content. I have chosen convenient examples.

You will all have come across black shales and connected than with deep water reducing conditions. Hydrogen sulphide is produced by anaerobic (without oxygen) decomposition of organic matter by bacteria. Hydrogen sulphide is the reducing agent. It forms metal sulphides which are often black or at least, dark coloured.

You also relate reddened sandstone to desert conditions - hot and dry and in the air because of the presence of iron III. Oxygen is the oxidising agent.

As with colour these are convenient examples. My oversimplification does not always completely explain the facts.

If any of this needs further explanation I will try to help. Otherwise I will find someone who can! Also if there are any other topics you think I might be of assistance I am prepared to have a go.

PERIODIC TABLE OF THE ELEMENTS

ALKALI METALS (Group 1)

ALKALINE EARTH METALS (Group 2)

NON-METALS → (from Group 3)

TRANSITION ELEMENTS

GROUP / PERIOD	1	2											3	4	5	6	7	0
1	H 1																(H) 1	He 2
2	Li 3	Be 4											B 5	C 6	N 7	O 8	F 9	Ne 10
3	Na 11	Mg 12											Al 13	Si 14	P 15	S 16	Cl 17	Ar 18
4	K 19	Ca 20	Sc 21	Ti 22	V 23	Cr 24	Mn 25	Fe 26	Co 27	Ni 28	Cu 29	Zn 30	Ga 31	Ge 32	As 33	Se 34	Br 35	Kr 36
5	Rb 37	Sr 38	Y 39	Zr 40	Nb 41	Mo 42	Tc 43	Ru 44	Rh 45	Pd 46	Ag 47	Cd 48	In 49	Sn 50	Sb 51	Te 52	I 53	Xe 54
6	Cs 55	Ba 56	La* 57	Hf 72	Ta 73	W 74	Re 75	Os 76	Ir 77	Pt 78	Au 79	Hg 80	Tl 81	Pb 82	Bi 83	Po 84	At 85	Rn 86
7	Fr 87	Ra 88	Ac** 89															

*	LANTHANIDES	Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	Ho 67	Er 68	Tm 69	Yb 70	Lu 71
**	ACTINIDES	Th 90	Pa 91	U 92	Np 93	Pu 94	Am 95	Cm 96	Bk 97	Cf 98	Es 99	Fm 100	Md 101	No 102	Lw 103

Shaded elements are those I have mentioned and are commonest in Geology.

Cath Clemesha

Shropshire 25. Some Thoughts from the Milton Keynes Outlier

Do you remember when :- The government abandoned the channel tunnel
A colour television licence went up from £12 to £18
Charlie Chaplin was knighted in the New Year's Honours

Those with better memories than I might recognise the year as 1975. You will probably not know that 1975 was also the last occasion that this author was on a Shropshire geological field trip. A long time ago, now. From the list above it can be seen that many things have changed since then, but surely the Shropshire geology is the same! Is it? Read on!

Preston Montford Field Centre

The venue was the Preston Montford Field Centre, a few miles outside Shrewsbury, on 18 August 1995. It was my first visit to a field centre, previous geology trips having been centred on local hotels. A colleague, who had stayed there as a youthful earth sciences student, described the accommodation as a collection of very basic, mouldering wooden huts some distance from the refectory and lecture facilities in the main building. This information, coupled with an 18 year absence from practical geology, fostered some speculation as to how the week would turn out!

On arrival there was no sign of the wooden huts. The accommodation was in Darwin House, a modern building of excellent standard. Each study-bedroom was en-suite. Also, in the large building there was a common room with kitchen, bar and a large lecture room and laboratory area, where we were to spend a lot of time over the next six days.

That Friday the course tutor, David Cronshaw, provided an introduction to the structural geology and scenery of the county of Shropshire together with an itinerary for the following day, describing where we were going and what we were going to see.

Shropshire Geology

In simple terms, the county of Shropshire is divided into two parts by the River Severn running approximately east to west. The scenery to the north is undulating, consisting of relatively soft New Red Sandstones. To the south the rocks are much older, alternating in hard and soft layers. These rocks outcrop as a series of parallel hills and valleys forming very much a corrugated landscape. All of northern Shropshire was ice covered and is now blanketed in drift and glacial deposits. The Shropshire hills to the south were not affected by glaciation.

Cutting across the centre of the county, running north to south, the Church Stretton Fault, England's largest fault, divides the area into two quite distinct regimes. It was exposures near to this fault that were to be visited on the first full day.

Day 1. Pre-Cambrian/Cambrian

A number of disused quarries in the Pre-Cambrian and Cambrian were visited in The Ercall and Lawrence Hill, two hills immediately to the east of the Wrekin Fault, a component part of the Church Stretton Fault system.

Ercall Quarries Ercall Wood Quarry, nearest to the fault, is granophyre, a Pre-Cambrian, pink, fine-grained volcanic rock. Cracking and shattering has occurred due to the proximity of the fault.

Kaolinisation has also occurred, resulting from circulation of hot water associated with movement along the fault. Further away from the Wrekin Fault the granophyre is darker in colour and less altered.

The larger quarry, an SSSI on the southern flank of The Ercall, had much of interest. The Pre-Cambrian/Cambrian boundary was seen as a basal conglomerate containing angular clasts and clay partings, lying unconformably over the Pre-Cambrian granophyre. The angular clasts were volcanic in origin and contained examples of banded rhyolite, rhyolite, granophyre, chlorite and volcanic ashes. The angularity indicated little transport and nearby volcanic activity.

The Pre-Cambrian/Cambrian boundary was faulted at the quarry entrance and displaced horizontally to reappear approximately 100 metres to the north west.

The conglomerate, indicating a marine transgression, was succeeded by a quartzite, most of which has been removed by quarrying. The quartzite is blocky, uniform in appearance and contained no fossils. It was deposited in a high energy environment.

Above the quartzite, but not accessible from ground level, was the Comley Sandstone. This comprised layers of sandstone, siltstone and mudstone deposited in sequence due to seasonal changes in deposition.

Lawrence Hill Quarry Returning towards the Wrekin Fault, Lawrence Hill Quarry exhibited quite a different rock. Purple bands of bedded, volcanic ash were seen steeply dipping to the north west. Their glassy appearance indicating fine grained deposition under water.

Similar vitreous tuffs were also exposed at the last quarry visit if the day, Forest Glen Quarry. In this location, also near the Wrekin Fault, the layered volcanic ash was intruded by dolerite.

The Evening Surprise

Arriving back at the field centre and following the evening meal there was no relaxation. The evening session continued with a description of the recent glacial history of the area around Preston Montford and a short walk to the first "Evening Surprise", an exposure of varved clays on the bank of the River Severn. The varved clay exposed was about 2 metres in thickness, was well bedded and consisted of 1400 individual layers, 700 pairs of alternating coarse and fine layers. Nobody checked this information by counting them! The seasonal deposition of the varved clay took place in Lake Lapworth, a glacial lake dammed by a terminal moraine seen today as a low ridge to the east of the field centre. Large clasts seen in the deposit were deposited from melting icebergs.

Pre-Cambrian/Cambrian Geology

Returning to the field centre, the session continued with a review of what had been seen during the day together with an interpretation of the evidence as applied on a regional basis.

The major period of Pre-Cambrian volcanic activity occurred about 700 million years ago and was related to the melting associated with the descending plate of a subduction zone active at that time. The Church Stretton Fault was active at the same time. This volcanic period was followed by a period of folding and erosion. The next stage was a Cambrian marine transgression giving rise to a conglomerate deposit containing clasts of original volcanic material. This phase was followed by deposition of a quartzite which was followed by sandstone and shale.

The Cambrian rocks, together with the underlying Pre-Cambrian, were folded and eroded. This phase was followed much later by the deposition of the Carboniferous limestone and sandstone. These and the underlying rocks were folded again. Thus, the Pre-Cambrian has experienced three periods of folding, accounting for the fractured nature of the rocks of this area.

Day 2 Ordovician

The lower Ordovician to the west of the Church Stretton Fault was visited during the day. After a break in deposition at the end of the Cambrian, the Stiperstones Quartzite was deposited unconformably on the Cambrian, forming the base of the Ordovician. The overlying Mytton Flags are medium grained sandstones with shaley partings. The Mytton Flags contain a large number of mineral veins and were economically most important for lead mining. The succession continued with the fine grained Hope Shales and the Stapeley Volcanics. During this period of the Ordovician there were a number of volcanic episodes giving rise to a large number of igneous intrusions.

Poles Coppice Quarry. The first visit to the Stiperstones Quartzite was at this quarry. Here the beds were almost vertical with conglomerate beds containing rounded clasts of Pre-Cambrian sediments. There were a number of interesting features seen in this quarry. The beds at the top of the quarry face were deformed, or flextured, due to the effect of soil creep on the surface above. Thin, black, bituminous deposits were seen to cut across the bedding planes. These were postulated as originating from overlying Coal Measures, now removed. They cannot have originated in the Ordovician as there was no vegetation to decay and act as a source.

Without doubt, the star attraction of Poles Coppice Quarry were the ripple marks. These are large; 60 cm. crest to crest, 15 cm. crest to trough. They are not easily accessible but are well worth the scramble to look at them.

Snailbeach Mining Site Mineralisation of the Mytton Flags was studied next at the Snailbeach mining site. This is interesting for the industrial archaeologist as well as the geologist. The site has been landscaped and the remaining mining buildings are being restored.

Galena has been mined at Snailbeach since Roman times, but is now rare in the remaining mine debris. Sphalerite is common. Calcite is very common and was worked for pebbledash. Barytes has also been mined in more recent times. The mineralisation was caused by circulating fluids confined to the Mytton Flags by the overlying Hope Shales.

The Snailbeach mining site did give me some problems, originating from Ted Finch's geology evening classes in Farnham during the early days of the Farnham Geological Society. There must be one or two readers of this account who remember Ted's dictum, " Geology is not real geology unless it is in situ ". That is not to say that on those early field trips picking over mine spoil heaps was forbidden: it was classified as 'booty hunting' and had to be carried out outside of the geological working day. This meant semi-secretly, before breakfast, in the half light of a gloomy autumn morning. There are now few members who remember "The Adventure of the Search for the Green Grossular Garnets of Devonshire ". That is a story remaining to be told! I assuaged my feelings of guilt of 'booty hunting' on this occasion by looking around the industrial archaeological remains as well!

Shropshire scenery. Some of the fine scenery of Shropshire was seen at the third stop of the day, Burgham Corner Viewpoint, the first of many attractive viewpoints seen during the week. The view was to the north east looking along the grain of the corrugated landscape of south Shropshire. To the east was the Mytton Flags on the west side of the Stipperstones ridge. In the centre, forming the valley floor, were the

Hope Shales. To the east were the younger Stapeley Volcanics of Buxton Hill. This pattern of hard rock ridges, interspersed with shale valley floors, was to be seen many times and gives rise to the corrugated landscape characteristic of the area.
There was a small quarry site at the viewpoint where a dolerite dyke had intruded into the Mytton Flags. The dyke had eroded away but the baked margins remained, having been recrystalised into a hornfels.
The Stiperstones. The vantage point of the Stiperstones ridge gave a view to the east over a Cambrian shale valley to the Pre-Cambrian Western Long Mynd ridge. To the west, the view was over the Mytton Flags, a Hope Shales syncline in the valley floor and to the Mytton Flags exposed again on Shelve Hill.
The Stiperstones Quartzite tors along the Stiperstones ridge are not in a straight line. They have been displaced out of line by a series of transverse faults. These faults have given rise to valleys, such as Snailbeach, where mineralisation in the Mytton Flags has been concentrated.
The Stiperstones have suffered extreme frost shattering, being above the level of glaciation. One other glacial feature seen on the ridge was patterned ground. This resulted from a radial sorting process whereby ice caused upward doming of the land surface so that coarser material moved down the slope to the margin leaving finer grained material in the centre.
Hope Quarry. This last site visited was where I learned, or relearned after 18 years, I cannot remember which, the difference between competent and incompetent beds. Having done so , it didn't appear entirely logical. The exposure in the Hope Shales was of intensely distorted beds of fine grained, volcanic ash interbedded with shales. The brittle 'competent' volcanic ash beds have fractured under stress. The ductile 'incompetent' shale beds have distorted under stress but not fractured.

Nesscliffe Quarries. The second "evening surprise" was a visit to a faulted and uplifted block forming a hill in the flat, Permian New Red Sandstone landscape north of the River Severn.
The two quarries of Nesscliffe were very much a surprise. They looked unnatural. The flat, uniform quarry faces with right angled corners had more of the appearance of some massive, windowless building than of quarry faces. This impression was reinforced by Kynastons Cave high up in the quarry face; a man-made cave with ornate doorway accessed by carved stone steps.
The soft, river-lain, cross-bedded, red sandstone was used as a building stone for Shrewsbury Castle. The regular sandstone blocks were cut directly from the quarry face, giving rise to the vertical faces and uniform pattern of herringbone quarrying marks seen today.

Day 3 Ordovician/Silurian
The Ordovician to the east of the Church Stretton Fault was the main topic of the day in contrast to western exposures seen on day 2. In addition, a series of exposures were examined around the southern end of the Long Mynd looking at the Pre-Cambrian/Silurian boundary to the west of the Church Stretton Fault.
Southern Long Mynd. The first stop was at Hillend, the most southerly tip of the Long Mynd. A roadside exposure showed the Silurian basal conglomerate, the Kenley Grit, lying unconformably as a beach deposit on steeply dipping Pre-Cambrian sandstone of the Eastern Uriconian.

Hillend Farmhouse, 200 metres to the east, was built on this beach deposit. The steep southern flank of the Long Mynd to the rear of the farmhouse is believed to be a series of Longmyndian sea stacks on the site of the Pre-Cambrian coastline.

A further 200 metres to the west, the fossiliferous Pentamerus Beds were exposed. These were siltstones with limestone bands and they succeeded the Kenley Grit basal conglomerate. This indicated that the initial marine transgression had been succeeded by a period of widening and deepening of the sea with warm, shallow, low sediment depositional conditions for the limestones and an occasional higher sediment input for the siltstones.

Onny Valley Trail. The Onny Valley section commences in the east with an unconformity between the Onny Shales of the Upper Ordovician and the Silurian Hughley Shales which succeeded the Pentamerus Beds. The latter are missing in this exposure. Folding, uplift and erosion of the Onny Shales has occurred followed by deposition of Hughley Shales. If there was an award for the most unconvincing unconformity then this would be my favourite. A difference in dip of 4 degrees and no obvious difference in appearance between the beds make the boundary difficult to see, even when it is pointed out.

Walking west along the valley towards the Church Stretton Fault is to walk over progressively older beds. The Acton Scott Group were not exposed. The Cheney Longville Flags, green flagstones with some evidence of cross bedding, were seen in the valley side.

A small exposure of the Alternata Limestone, a biogenic deposit consisting of abundant fossil shells, was seen before stopping at a restored railway overbridge built out of the Chatwall Sandstone. The sandstone is an attractive red/buff coloured stone with some fine examples of cross bedding.

The succeeding Chatwall Flagstones and Harnage Shales were not seen.

The Glenburrell Quarries contained exposures of almost vertically bedded Hoar Edge Grit, a well bedded, calcareously cemented, cross-bedded, quartzy gritstone. In the upper quarry, the Hoar Edge Grit was underlain by thin yellow/green clay beds, 2 metres of red sands and a purple, Pre-Cambrian sandstone. Both the clays and the sand were deeply eroded.

The exposure was postulated as being a shatter zone on a branch of the Church Stretton Fault. The calcareous cement has been removed from the grit by hot waters associated with the faulting, leaving the quartz sand. The clay is believed to have been deposited post faulting.

The Great Geological Mystery

Now patient reader, we come to the enigma alluded to in my introduction. Those of you who were on the anniversary field trip will know that I took copious notes, perhaps unwisely, as I became a prime candidate for writing this account. I did the same on my last visit to the Onny Valley in 1975. According to my field notes, in the last 20 years the Onny Valley Ordovician/Silurian unconformity has moved upstream by approximately 20 metres. At a rate of 1 metre per year, this example of unconformity drift puts continental drift in the shade!

As with most revolutionary new theories, there is an alternative explanation. The difficulties experienced in actually seeing the unconformity, as mentioned earlier, compounded by the fact that we could only view it across a river, could possibly mean that observational error has occurred. I offer the evidence and leave the reader to judge.

What is undeniable is that the location was a pleasant spot to sit in the sun and eat lunch (author's wife).

Hope Bowdler Unconformity

This was a small unconformity near the village of Hope Bowdler, important enough to have its own signpost describing what was to be seen. The Ordovician Harnage Shales lie unconformably on Pre-Cambrian rocks of Uriconian age. The older Hoar Edge Grit, present but not seen in the Onny Valley, is missing here.

Architectural Appreciation. Monday's "evening surprise" was a visit to the fine village hall at Alberbury. In the car park there was an exposure of what is believed to be a wadi deposit in the Permian New Red Sandstone, consisting of a sandstone matrix containing quartz pebbles and fossils with both angular and rounded clasts. This is indicative of a seasonal, high energy environment with little transport of the clasts. The best examples seen were incorporated in the exterior stonework of the village hall, giving it the probable distinction of being the most closely studied building in Shropshire, judging by the attention it received that evening.

Ordovician Geology The briefing session considered the differences between the Ordovician exposures seen on day 2 in the Stiperstones area and those on day 3 in the Onny Valley section; the former is to the west of the Church Stretton Fault, the latter to the east

The differences were quite marked. To the west there was mineralisation, few fossils, major folding, thick sedimentary units, deeper water deposits with the presence of volcanics, igneous intrusions and metamorphism. To the east of the fault there was no mineralisation, many fossils, minor folding, thinner sedimentary units, shallow water deposits with no volcanics, igneous intrusions or metamorphism. Much of the lower Ordovician was absent.

The explanation was related to continuous movement on the Church Stretton Fault since the Pre-Cambrian. The west has experienced a downthrow of thousands of metres. The east has remained relatively static and acted as a resistant block.

The lower Ordovician is missing in the east, indicating a period of erosion. At the same time, the west was experiencing deep water deposition and volcanic activity.

Subsequent movement caused deformation of western beds but had little effect on the eastern beds.

During the upper Ordovician the sea covered the whole area, with shallow water over the resistant eastern block and deeper water over the downthrown western block, giving the different depositional characteristics observed.

Day 4 Silurian/Old Red Sandstone/Carboniferous

The Silurian rocks exposed in the core of the Ludlow anticline were visited. The anticlinal axis runs approximately west to east with Ludlow at its eastern extremity. The anticline plunges in an easterly direction.

Two exposures in the Old Red Sandstone were also seen, including the Ludlow Bone Beds. A brief visit was also made to the Carboniferous at Titterstone Clee Hill.

Mortimer Forest. Vinnalls car park is situated in the weathered centre of the plunging Ludlow anticline. From here, the scarp slopes on either side of the anticline are seen. In a nearby quarry the exposed Wenlock Limestone was nodular in appearance. The point of interest in the quarry face was a hollowed out band of bentonite clay, dipping slightly to the east. The bentonite formed from the breakdown of volcanic material. As there was no Silurian volcanic activity locally, the sediment forming the clay band must have been transported from some distance.

The younger , succeeding Lower Ludlow Shales, a fossil rich, calcareous, silty mudstone, were seen in two exposures adjacent to the forest track leading from the car park. Many people extracted numerous fossil fragments from here - trilobites, cephalopods, bivalves, brachiopods and gastropods. For myself, not being practised at this art, I found little.

The depositional environment for the shales was calm and shallow water with a steady sediment supply.

Ludlow Bone Beds No geological visit to Ludlow is complete without a visit to the Ludlow Bone Beds at Ludford Corner. This is another site that warrants its own explanatory signpost. The beds contain the remains of primitive fish, their first occurrence in the stratigraphical column. To someone not warned beforehand that these remains are on a microscopic scale, the bone beds look very ordinary.

The Ludlow Bone Beds occur at the base of the Old Red Sandstone Downton Beds and mark a change in sedimentation from the underlying marine Silurian to estuarine and freshwater conditions during the Lower Old Red Sandstone. The cause of this change was earth movements in the vicinity, causing uplift and shallowing of the sea.

Titterstone Clee Hill Coal measures, resting unconformably on the Cornbrook Sandstone of Millstone Grit age, form the prominent outlier of Titterstone Clee Hill, set in an Old Red Sandstone landscape. They comprise a basal sandstone overlain by Productive Coal Measures which are intruded by a Carboniferous Dolerite sill.

We stopped briefly at Titterstone Clee Hill to see that 15 metres of Productive Coal Measures had been removed from the top of the hill. The dolerite, quarried for roadstone, remained.

Farlow Another exposure in the Lower Old Red Sandstone was observed near Farlow Brook, close to the village of Farlow. A medium grained sandstone overlies a yellow Shropshire Cornstone - a fossil soil produced in tropical conditions with little rainfall. Both were overlain by pebble beds, exposed by the roadside near the village.

The cornstones occur in the Ditton Series which succeed the Downton Series, the base of which was seen at Ludlow. The sediments are continental in origin and comprise a rhythmic sedimentary succession resulting from the periodic flooding of an extensive delta. The cornstone was formed by the breaking up of the deltaic deposits by the periodic flooding and the chemical precipitation of concretionary limestone from the remaining floodwaters.

Roger Ashcroft

The remainder of Roger's Shropshire trip will be published in the SPRING NEWSLETTER.

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IMPORTANT NOTICE: The AGM will be held on Friday, 17 January 1997 at our usual venue and time. Meeting followed by **Chris Andrew** of Haslemere Museum lecturing on **Jurassic Fossils.**

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