GEOLOGICAL SOCIETY

HISTORY OF GEOLOGY GROUP NEWSLETTER

No. 11.....February 2000

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William Smith Millennium Meeting: CELEBRATING THE AGE OF THE EARTH

June 28/29, 2000

Geological Society of London, Burlington House, Piccadilly, London W1V 0JU
Co-sponsored by the Geological Society of America

At the close of one Millennium and the dawn of another the History of Geology Group is holding a two-day interdisciplinary symposium on geological time, under the auspices of the Geological Society's William Smith Lecture meeting.

The objective of the meeting is to re-create in modern times the atmosphere of interdisciplinary discussion that prevailed at the end of the 19th century when geologists, biologists, physicists, chemists and astronomers came together to hotly debate the Age of the Earth. Accordingly, we have invited geologists, geochemists, historians of science, a biologist and an astrophysicist to contribute to this very special occasion.

Meeting Programme

Convenor: Dr. Cherry Lewis. Email: clelewis@aol.com

Wednesday 28 June 2000

09.30 REGISTRATION

10.00 COFFEE

10.30 Welcome Address

10.45 Keynote Address: **Time, Life and the Earth.** Professor Aubrey Manning

11.30 **Before the Hills in Order Stood: The Beginning of the Geology of Time in England.** Dr. John Fuller

12.00 **The Time of Genesis and the Time of the Rocks: The European View.** Professor Ezio Vaccari

12.30 LUNCH

14.00 **Nature's Own Chronology.** Professor Ken Taylor

14.30 **Time, Geology and Fossils in the Age of Cuvier and Lyell.** Professor Martin Rudwick

15.0 **Genesis and Geochronology: The Case of John Phillips (1800-1874).** Mr. Jack Morell

15.30 TEA

16.00 **Measuring Geological Time.** Dr. Joe Burchfield

16.30 **John Joly and his Determinations of the Age of the Earth.** Dr. Patrick Wyse Jackson

17.00 Discussion

17.30 Wine reception, Lower Library

18.30 WILLIAM SMITH EVENING LECTURE: **Timeless Order: William Smith and his search for raw materials.** Professor Hugh Torrens.

19.30 Celebration Supper, Upper Library

Thursday 29 June 2000

10.00 **Is the Earth Too Old? When the Earth was Older than the Universe.** Professor Stephen Brush

10.30 **The Dating Game: Arthur Holmes' Vision of a Geological Time Scale.** Dr. Cherry Lewis

11.00 COFFEE

11.30 **Stones and the Voices of Time.** Professor Gerry Wasserburg

12.00 **The Oldest Rocks on Earth: Time Constraints and Geological Controversies.** Professor Stephen Moorbath

12.30 LUNCH

14.00 **Fossils as Geological Clocks.** Professor John Callomon

14.30 **Tracing Earth's Age and Evolution.** Professor Al Hofmann

15.00 **Dating Modern Human Origins.** Professor Chris Stringer

15.30 TEA

16.00 Keynote Address: **Understanding the Beginning and the End.** Professor Sir Martin Rees

16.45 Discussion

17.30 Close

This meeting is co-sponsored by the Geological Society of America and the Royal Society.

GSA logo

Royal Society logo

Friday 30 June 2000

Time-related **field trip** to the Wealden and other geologically historical locations in the vicinity. Lead by Professor Hugh Torrens.

Online registration and Second Circular: http://www.geolsoc.org.uk
or contact the conference office for a registration form.
Tel: 0171 434 9944 Fax: 0171 494 0579 Email: ruth@geolsoc.org.uk

This meeting is already proving very popular. Please register early to avoid disappointment.

And the previous HOGG meeting...

This meeting, conceived at short notice following the staffing problems at the British Geological Survey, was held at Burlington House, Piccadilly, London on 30 November 1999. The theme was "**Geology in the Field**".

John Fuller: The Prehsitory of Geological Fieldwork

One commonly reads in books that the period from 1790-1820 was "the heroic age of geology". What happened in ear5th science before the heroes arrived? Who dug in the earth for coal and iron ore? Who found salt to preserve food for the winter? Not the metropolitan gentry, but ordinary workmen applying experience and the principles of their trade to earning their livelihood.

The reason why we know anything at all about these pre-metropolitan explorers is that from time to time a particular figure emerged, who bridges the gap between practical workmen and academic writers; to someone, in short, who had both knowledge of the rocks and the ability to write about them.

Such people were few, not because knowledge and experience of geology were in short supply, but because skilled practitioners in the extractive industries, as in all ancient crafts, were unwilling to divulge their knowledge to strangers.

A further condition bearing on the development of field geology, not less important than the rarity of informed writers, was the fact that there was no order to the geology of superficial outcrops, before the principles of subsurface geological order were understood. To reiterate, outcrop geology became important only after subsurface order had been understood. And by the word 'order' is meant 'natural order' or 'created order'; it has nothing to do with sequence, succession. Rank or time, but it does have to do with observation, measurement, and common sense. The works of six people illustrate these points.

John Leland was appointed in 1533 by King Henry VIII to make an inventory of the holdings of monastery libraries. He traveled the whole country, and in doing so, met and questioned workmen, and wrote down their answers. He visited Cocket island and recorded the deposits of the many coal pits there. He recognized that Durham was built on Coal measures rocks, and that they spread laterally. In other words he visualized it in 3 dimensions. Later he visited Tenby, & Lampeter in South Wales, and at llaneli and Kidwelly was able, in 1540, to distinguish between anthracite & bituminous coals.

Thomas Waike made a borehole log on a boring at Manton for coal in 1639. This log was so accurate he was able to solve 3-point problems to determine the full thickness of the Beeston Coal.

James Stringer was able to map the outcrop of coal and Silurian Limestone in the Dudley area. He found that it formed a rough circle.

Dud Dudley, a famous ironmaster, measured the thickness of 10 beds of coal and ironstones, in units. He arrived at a total thickness of 48 feet. Several hundred years later, the measured thickness was given as 47 feet 6 inches. In 1665 he made a geological map of the Dudley coal. The map looks strange, but there were no maps before, so there was nothing with which to compare it. Trade depended on well armed ships, for which iron was need for the guns. Some of these were made in Sussex, and one ironmaster is known to have sent a log of the Wealden series to Hans Sloane.

Francis Hawksbee went to Dudley and measured the specific gravity of 30 samples, and in 1712 was able to produce a sub-surface density log. This destroyed the earlier theory of John Woodward, that strata were the result of a kind of precipitated reconstituted soup, allowing the densest to sink to the bottom.

John Stracey, lived at Sutton Court, Somerset. He noticed the unconformity near Taunton and was able to make a geological map of the coal deposits showing the true dip. Again sub-surface geology was needed as the area is covered by Triassic/Jurassic deposits.

Hugh Torrens: Coal Hunting in Batheaston,Bexhill and Brewham 1804-1813. Practice where it mattered most.

1750 to 1815 was the age of revolutions; Britain's was industrial. In 1787 John Williams noted that Britain benefited more from the products of the bowels of the Earth than did any other nation. At the time Britain was at war and was in need of coal, and this was sought all over the country wherever blue clay was found. But there was confusion with the Blue Lias, Oxford Clay and Kimmeridge Clay, all of which are bluish, but none of which is associated with coal deposits. John Player was aware the rocks were ordered but was unable to work it out properly. William Smith, working around Bath, had noted unconformities and beds missing between the Triassic and Carboniferous, and between the Oxford Clay and Corallian beds. Smith had far greater knowledge than others, and his detail was better, and he was very free in divulging the order to anyone who wanted to know. He had pupils like John Forey who worked at the rules Smith used to work out the order. Smith came from the working classes and had great difficulty in getting into print, but in 1801 he was able to publish his *Accurate Determinations & Descriptions upon the Natural Order of Strata etc*, even though his publisher went bankrupt twice! Just before, in 1790, he went to the Shoe Inn at Playford in the New Forest to see attempts to find coal in deposits opposite. It was another case of the blue clay deceiving the privateers, and Smith had no problem in dismissing it. At Brewham in Somerset, Smith visited on 24 March 1805, a trial for coal where the shaft had been dug to 120 feet. In the spoil he found examples of Gryphaea (now housed in the NHM, London), proving that the Kellaways Rock (basal Upper Jurassic) had been reached, and from this alone he was able to say that the trial was a waste of time. Nonetheless, the privateers carried on in vain hope for 5 more years, eventually reaching 650 feet before abandoning the project. A final call to shareholders in the ill-fated venture returned only 15 shillings, but it enabled Smith to tell a friend that he could only fix the Kellaways Rock in this area as a result of the diggings.

Another attempt to find coal was made at Bexhill in Sussex after builders constructing a barracks found lignite. They were misled into thinking it was coal by the associated blue clay -Wealden Clay- that was found to contain fossils of dinosaurs. John Forey visited in 1806 and instantly saw the problem from the stratigraphy. The whole venture cost £30,000, and was supported by some eminent people.

The trial at Batheaston was inspired by a Mrs Brown from Shropshire. Recently widowed, she moved to Evesham (Worcestershire), and, with a consortium of 214 shareholders, attempted to find coal in a field. Again they were misled by the similarity of the blue clays. Mrs Brown lost nearly £6000 in the project. It was suggested that Batheaston might yield results. Smith was called in, and 2 shafts were sunk then bored from depth. Smith failed but it was a scientific attempt. There were many more. Smith

was unable to convince the Geological Society of the problems, and Britain failed to teach what it knew. Much later, as Dean Buckland lectured at Oxford, there were still people digging for coal on a nearby hill, which they should have know was barren.

Simon Knell: John Phillips and friends on the Yorkshire coast in the 1820s

In February 1821, William Smith was in Scarborough, and here Smith handed his nephew John Phillips three fossils. Amongst them was *Gryphaea dilatata* – the same fossil Smith had used to decide the likely failure of the Brewham trials for coal (see report of Hugh Torrens' talk, above). John Phillips, Smith's assistant and nephew looked at these fossils and immediately saw them as indicative of the Kellaways – a rock he and Smith knew from Chippenham in Wiltshire which both had assumed to be of local distribution. Here the fossil indicated a more positive result – it began to indicate the fullness of a possible cross-country correlation. But Smith remained cautious. His was not simply a search for characteristic fossils or the pursuit of stage coach geology. The Yorkshire coast with its own peculiar rock series was the great testing ground for the Smithian method. This method can only be fully understood by unravelling the origins of Phillips's own use of fossils. It was a method which used fossils in a much more sophisticated way than has previously been assumed.

In 1829, Phillips produced his great book on the geology of the Yorkshire coast. It was Smith's *Stratigraphical System*, and a transmission of Smith's ideas into the realm of gentlemen on Smith's terms. Phillips's book was built on some of the most rigorous fieldwork then seen in Britain. But don't envisage Phillips walking the coast collecting and measuring – the writing of this most remarkable geology book was much more involved than that. It concerned the selling of geology to coastal philosophers, nurturing collectors, encouraging the discovery of new fossils and new localities, using York colleagues to brainstorm ideas, exploiting dealers, and, turning the museum into a research tool, it called upon presidential campaigns in favour of support. The project began life as a broadly defined objective of the Yorkshire Philosophical Society, though no one then knew in detail how it was to be achieved. The story is told in detail in Simon's forthcoming book.

Alfred Whittaker: Sir Charles Giesecke's early 19th century field geology in Greenland.

Charles Lewis Giesecke Anglicized his name from the Germanic Karl Ludwig Giesecke, but started life as Johan Georg Metzler. He was born in 1761 in Augsburg, the son of a master tailor, and went to University in Goettingen where he studied law under Prof. Blumenbach . In 1783 he left University and having adopted his pseudonym took up the career of an actor, singer, playwright, opera author and translator. Betwen about 1793 and 1800, he abandoned this to become a mineralogist, but this did not stop him in 1819, visiting Vienna and, when meeting friends from the theatre, claiming authorship of most of the Magic Flute. He also inspired some of Goethe's writing. He got to know Ignatz von Born and became associated with him in a Masonic lodge in Vienna. Later he toured Scandinavia, where he was recognised as a mineral dealer, before travelling to Berlin, where he met Carstens, and then to Freiberg to meet Werner. There is no evidence of him being a student of Werner's but it is probable that he paid his own way to attend Werner's lectures. Werner had published in 1786 that there are 4 rocks types - ancient rocks, stratified rocks, volcanic rocks, and alluvium. After learning of the rock types, Giesecke

moved to Copenhagen and the Danish Court, where he heard about the Danish colony on Greenland. He traveled to the Faroes and then to Greenland, where he remained for 7 years! During this time he collected many minerals, some of which were original, and in 1817, Sowerby named Gieseckite in his honour. He was first to find the mineral cryolite at Ivigtut (but not to describe it). The mineral formed the basis of the aluminium industry and the Ivigtut mines supplied the world until well into the 20th century. He moved on to Disco Island and its capital Godtharb. He described the geology including strange basalts which showed steps ("treppen" In German, hence 'trap basalt'), and he mapped sandstones on Weigatt between Disco Island and the mainland. He also described 'globular' masses of basalt - the first note of pillow lavas. In all he correlated rocks over a distance of 2000 miles! On his return to Leith, near Edinburgh, he met Thomas Allan, who was buying the cryolite cheaply. Giesecke went to Allan's house and it was suggested he took up a post in the Dublin Society (later the Royal Dublin Society), which he did. He was given a knighthood by Denmark, and took up the name 'Metzlar von Giesecke'. When he died, a memorial stone was placed in St George's Church, Dublin.

Patrick Boylan: WilliamBuckland's cave explorations

William Buckland was born in 1784 and died in 1856. He became President of the Geological Society and from 1813 was a reader of geology at Oxford, where in 1818, the Regius Chair of geology was erected. The Napoleonic wars of the early 1800s disrupted travel between Britain and the Continent and the isolation caused invertebrate palaeontology to be distorted between the publicly funded Cuvier in France and his poorer compatriots in the UK. Here the science was 'misappropriated' by the medical profession, od which Hunter of the Royal College of Surgeons was one of the first to become involved. By 1815 there was a second generation of Hunter's pupils of which Parkinson (latterly of disease fame) is probably the best known. A key figure in terms of looking at fossil bones was Sir Everhard Hulme of the Royal College of Surgeons, though he is now seen as a plagiarist. Buckland was lucky in that he had travelled in Europe, had met Werner, and by 1820, probably no-one else in the field had travelled further. Buckland focussed on hard rocks - his first major paper was on the Cross Fell inlier. Following peace in Europe, excavations started looking at cave systems, where large numbers of fossil bones were being found. Buckland's previous experience here was very important. In the middle of 1821, road metal was found to contain bones in quantity, and these were traced back to Kirkdale Cave. A mammoth tooth was found in a cavity through which it could not possibly have gone. This puzzle was presented to Buckland for his comments, and he went assuming it was a reliquary of the flood. But he found there was mud over the top of the bones, and so they were clearly pre-diluvian. Bones from below that level were virtually all chewed or broken, and Buckland 'convicted' the cave hyena of the crime, suggesting it might have been a nursery den. His published ideas of 1822 caused much controversy, especially among the clergy. In an attempt to prove his idea Buckland borrowed a hyena, tossed in part of an ox and waited. From the resultant bones he could see that only the most indigestible pieces were not eaten. Buckland's presentation caused a sensation. He later, in between acting as temporary curate in southern England, made journeys to look at caves in south & central Germany, France as well as the UK. At Wirksworth (Derbyshire he found a cave with classic evidence of a pitfall (remains which fell into a pit in the limestone). His work was significant in that it pioneered the scientific analysis of caves, and influenced later work

at kent's cavern. Buckland was also first to identify material at Kirkdale as dung of a hyena - a discovery which set him on a course of looking at all sorts of fossil dung!

Richard Wilding - Charles Darwin's geological fieldwork

Although Charles Darwin is nowadays thought mainly of as a biologist, for the duration of his *Beagle* voyage he considered himself as principally a geologist, and most of his early writings were on geological observations. His *Beagle* geological notes amounted to 1383 pages, while his zoological notes totalled only 368 pages. He started collecting minerals as a boy and learnt his early chemistry with his older brother. At Edinburgh he attended Hope's chemistry lectures and found Jameson's lectures on geology and zoology "incredibly dull".

He gave up his studies of medicine at Edinburgh to transfer to Cambridge with the intention of taking up holy orders. There, his friendship with John S. Henslow , Prof. of Botany, led to him looking again at the virtues of geological studies. Henslow persuaded Adam Sedgwick, Prof. of Geology, to take Darwin on a planned geological tour of North Wales in 1831. This served as a crash course in field geology for him, for Sedgwick was one of the great field geologists of the time.

One of the many things he learnt from Sedwick was the significance of 'slaty cleavage'. He was to develop the concept later in South America. On the *Beagle* he received much help and encouragement from the Captain, Robert Fitzroy, who presented him with the newly published 1st volume of Lyell's *Principles of Geology*, which he found his most useful guide to the way science should be approached..

At the first landfall, St Jago, he began to use Lyell's *Principles* in his fieldwork. He described the strata in carefully observed detail and used his mineralogy, also making chemical tests and analyses. Petrology was very different at that time before the invention of the petrological microscope. As a petrologist he was a pioneer in suggesting that fractional crystallisation in volcanic rocks could be a cause of varying lava types. On the Galapagos Islands he spent more time in studying the lava flows than in noting accurately in which islands the varieties of finches (and giant tortoises and mockingbirds) were found. Here his zoological notes were only 37 pages long compared to 109 pages of geological observations.

In his studies of volcanic islands he rejected Leopold von Buch's "craters of elevation" theory. His views here were later backed up by both G.P.Scrope and J.W.Judd, both distinguished vulcanologists. For Darwin, unlike von Buch, was never a 'catastophist'. He also noted that volcanic islands have no native metals, and no metallurgy amongst their inhabitants, while in such places as Chile, where there was metamorphism as well as volcanism, metallic veins were plentiful.

His theory of the formation of coral reefs, and his discovery of many of the bones of Tertiary mammals, later described by Richard Owen, were among the other major discoveries of the voyage.

In 1835, at Valdivia in Chile, he experienced an earthquake that caused extensive damage in nearby Conception. He incorporated his observations here into his thoughts on mountain-building, later incorporated in a paper, read in 1838, and published in 1840, in which he stated that mountain chains are formed slowly "by a succession of small movements"... and are produced by the same mechanism as produces earthquakes, continental elevations, and volcanoes. He had written in his notes"... I cannot avoid the conclusion that some great law of nature remains to be discovered by geologists".

After the voyage, he continued his geological work for a few years, until realising that failing health was forcing him to discontinue. Although *"The Origin of Species"* was one of the results of the ensuing more sedentary life, the loss to geology is probably immeasurable.

Michael Roberts: Charles Darwin in North Wales

I cannot escape from Darwin in my parish, as Fanny, his first girlfriend, lies in my chancel. Passing through Chirk is the Holyhead Road, canal and railway, all Robert Darwin' s investments. However I ignored my local geologist until reading Jim Secord's article in 1991 and followed up the footnote on Llanymynech with advice from Jim. The rest followed. The outline of Darwin's 1831 geology is known from his Autobiography. Few biographies get beyond that and miss the most significant aspect of Darwin' s scientific development.

My methods are routine; obtain copies of all of Darwin's notes (Cambridge University Library DAR 5) and maps (CULDAR 265; volunteered by Adam Perkins at CUL), copies of Sedgwick notes, (most useful has been a parallel copy of Sedgwick & Darwin's notes in the style of a Synopsis of the Gospels), copies of maps used by S & D - Evans's (1795) and Walker (1824), and Sedgwick's annotated copy of Evans's map, and then retrace their steps with much trial and error.

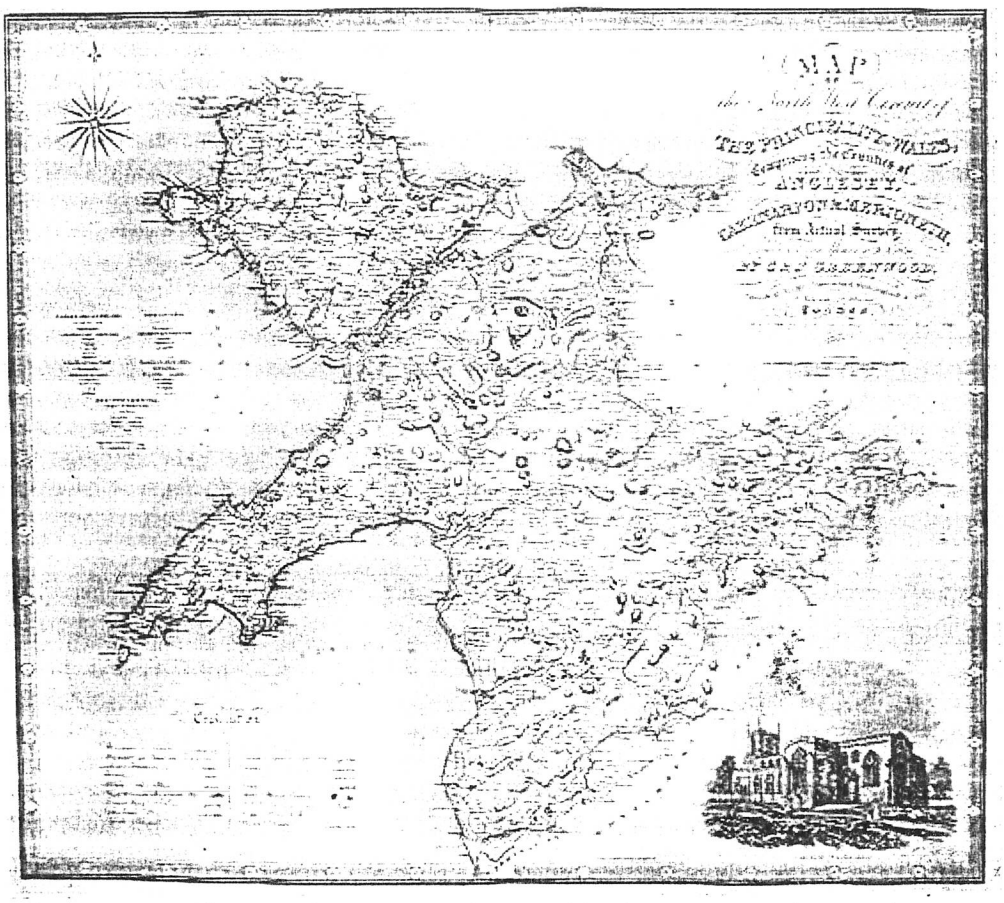
Initially following his autobiography and previous work, I thought that the sum of Darwin's work was i) Llanymynech, ii) Maps of Shropshire, iii) the Sedgwick-Darwin tour from 5 to 11 August from Shrewsbury to Bangor and finally iv) Darwin's solo walk to Barmouth. Three were straightforward but the Sedgwick-Darwin tour itself has been complex beyond expectation. My aim has been to work out routes and dates and then to consider how Darwin evolved as a geologist.

Darwin returned to Shrewsbury in mid-June 1831 and began his geology. He tried to make a map and made hand-drawn copies of parts of Baugh's (1808) map of Shropshire at 1" to 1 mile. Areas were coloured orange indicating New Red Sandstone. He also made maps of Llanymynech (North Wales in CUL DAR 265) and Anglesey from Evan's map at 7/8" to 1 mile scale. After he obtained a clinometer he visited Llanymynech and took 3 pages of indifferent notes. From his chemical notes I suspect he visited the Stiperstones area of Shropshire as well.

Through Henslow, Sedgwick was to take Darwin to North Wales. Many of Darwin's notes are undated and neither geologist is clear on topography. Looking at them synoptically has helped and in places I have tried almost every combination in the field. Cutting a long story short I found that to regard the length of the tour (5-11 Aug) indicated by Darwin's notes from Llangollen to Bethesda Quarry is too short. Clark and Hughes suggest two to three weeks. I independently came to that conclusion from circumstantial evidence. Not all will accept my argument!

Sedgwick arrived in Shrewsbury on 2 August presumably to stay with Darwin at "The Mount". For 3 and 4 Aug Sedgwick's notes describe forays to the southwest of Shrewsbury, looking mostly at Carboniferous, including the Cardeston limestone. Darwin probably accompanied him as it was the obvious thing to do and he referred to Cardeston conglomerate in his notes on the Pen Stryt Quarry near Ruthin.

The duo left Shrewsbury on 5 Aug and spent the following days seeing whether there was any ORS between the Greywacke and Carboniferous between Llangollen and Conwy. A key site is Pen Stryt. Darwin's main traverse from St Asaph to Conwy was to

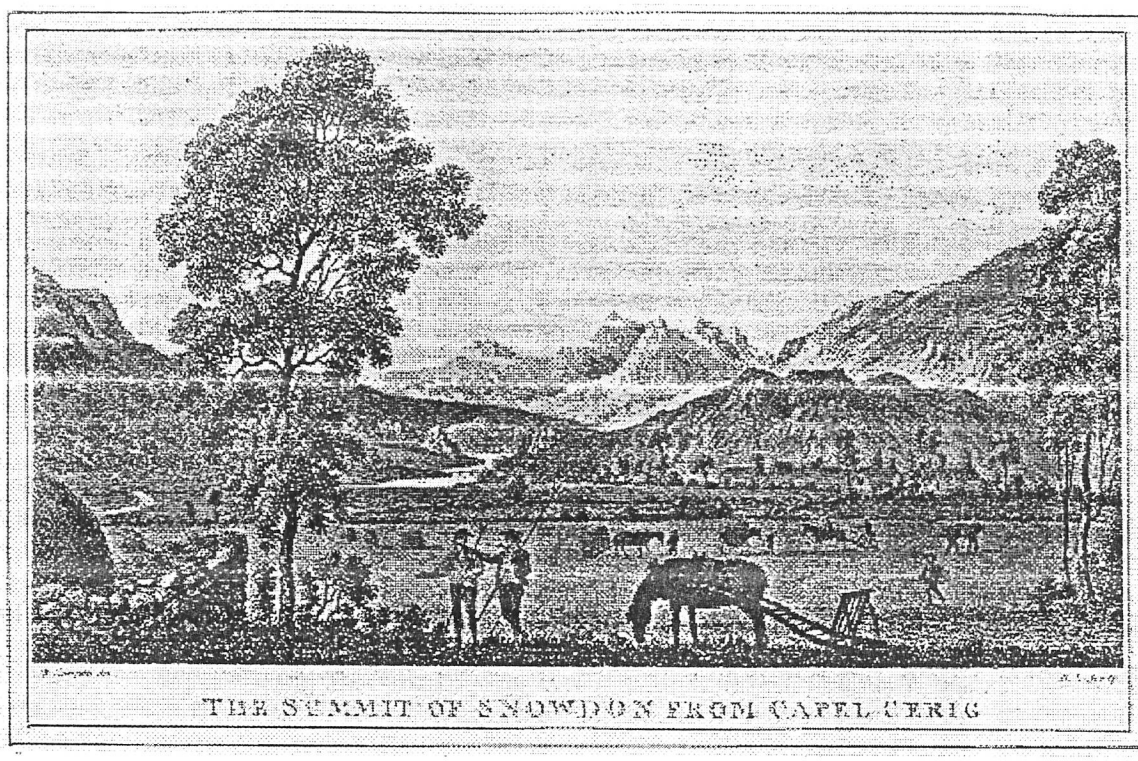


Caernarvonshire, Anglesey & Merionethshire by C & J Greenwood, 1834
(*from Atlas of the Counties of England*)

test whether there was any ORS. Darwin concluded no, and Sedgwick's field map records only Carboniferous east of the Little Orme. Future workers reversed this and it was not until c1900 that the contentious strata were seen as Basal Carboniferous. Simple as this part appears both geologists did considerable meandering.

From Conwy to Bangor the pair skirted the Carneddau serving as a reconnaisance for Sedgwick and an introduction to igneous and structural geology for Darwin. My argument that Darwin went round Anglesey and went to Dublin is circumstantial based on references to Anglesey in Beagle notes (CUL DAR 34, voyage and geology of the Beagle, Red and A notebooks, Falkands geology (PGS 1846) (of these only one out of 10 does not lie on Sedgwick's route of 12 to 20 Aug), the sudden improvement of Darwin's notes and Sedgwick's 4 September letter which only describes his activities from 21 Aug. On Anglesey Darwin made a considerable study of dykes, ancient quartz rocks of Holyhead (Mona), and allegedly ORS conglomerates.

They finally separated on 20/21 Aug at Menai or Caernarfon and Darwin made his last traverse - Cwm Idwal and Moel Siabod - before NOT following a compass bearing to Barmouth. His notes at Cwm Idwal are both wrong and excellent; wrong because he missed the syncline at Twll Du and described all volcanics as Basalt, and excellent because of his detailed observation and argument. His notes on Moel Siabod are better. He left an account of these at Capel Curig for Sedgwick. The improvement of Darwin's



"The Summit of Snowdon from Capel Curig", copper engraving by M.Griffith, c. 1790.

geology is best seen by reading through his notes chronologically and followed by those made at Quail Island on 17 Jan 1832. Darwin walked to Barmouth in two days during which he made a few notes. A few days later he was back in Shrewsbury and the rest is history.

Darwin's fieldwork of 1831 scarcely advanced geology, but it gives a window into how a geologist learnt his craft in 1831. It also shows a highly significant part of Darwin's scientific development, both how he learnt on his own and how he was tutored by Sedgwick. Sedgwick introduced Darwin to careful notetaking and field work and taught him aspects of igneous and metamorphic geology, mineralogy and structural geology. It is Sedgwick rather than Lyell who should be credited for Darwin's geological skills.

ROBERTS, M.B., 1996 Darwin at Llanymynech: the evolution of a geologist. *British journal for the history of science*, 29:469-78.
ROBERTS, M.B., 1998 Darwin's Dog-leg. *Archives of natural history* , 25:59-73.
ROBERTS, M.B., 2000 I coloured a map. *Archives of natural history* , 27.
ROBERTS, M.B., The Third Adam and his Disciple (forthcoming)
SECORD, J. A., 1991 The discovery of a vocation: Darwin's early geology. *British journal for the history of science*, 24:133-57.
CLARK & HUGHES, The Life and Letters of the Revd Adam Sedgwick, 1896.
(CUL DAR = Cambridge University Library, Darwin Mss, and number)

Neville Haile: G. A. F. MOLENGRAAFF(1860-1942):pioneer field geologist in Indonesia and South Africa

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Gustaaf Adolf Frederick Molengraaff was born in Nijmegen on 27 February 1860. He studied in Leiden and in 1886 took a doctorate in geology in Utrecht with a thesis on "The geology of the island of St. Eustatius" (in the West Indies); on the same day he obtained doctorates in botany and zoology by thesis. From then until 1931, he produced an almost yearly contribution to geological literature, of high quality and wide in scope, totalling 53 papers. In 1906 until his retirement in 1930 Molengraaff was Professor of Geology in the Technical Highschool in Delft; from there he continued his overseas research. This talk concentrates on his work in his main field areas: South Africa and Indonesia.

He spent five periods in South Africa, starting with an investigation of the goldfields of the High Veld in 1890, and subsequently worked as State Geologist of the South African Republic. He first surveyed an extensive area of the Transvaal, publishing the results in French and English in 1904. His work in South Africa was interrupted by the Boer War, during which he undertook humanitarian work in liaison between the British and the Boers; he incidentally introduced the idea of identity disks for combatants, subsequently in almost universal use. He took a special interest in the Vredefort Mountain Land, a complex area of plutonic and volcanic rocks southwest of Johannesburg, and published on this in 1903 and 1904.

In 1921 he resumed work in South Africa with American colleagues, investigating the Buschveld and with the Director of the South African Geological Survey, A.L.Hall, made a more detailed investigation of the Vredefort structure, publishing, with Hall, a

map and voluminous monograph (1925). The authors draw attention to the widespread evidence of shattering, and large amounts of pseudotachylite, a term which was coined by Schand (1917) from the Vredefort. The origin of this large domal structure, circular in plan, has subsequently been the subject of a large literature and an ongoing controversy. The first suggestion that it had been caused by the impact of a comet or asteroid appears to have been made by Boon and Allbritton (1936), but this was largely ignored until the 1940s, when Daly (1947) and others took it up. However, Haughton (Geology of South Africa, 1969) wrote "[The Vredefort structure] is of tectonic origin; there is little evidence to support the seemingly fantastic suggestion first put forward by Daly that it is the result of meteoritic impact and later supported by Dietz with his astrobleme theory." Evidence favouring impact steadily accumulated, but even as late as 1982 Tankard et al. opined "Coesite, stishovite in pseudotachylite and shatter cones on fault breccia may have led to the suggestion of meteorite impact but the authors favour an internal process." The confirmation of shock metamorphism effects in quartz (decorated PDFs and basal Brazil twins, diaplectic glass) and in zircon (PDFs and granular shock texture)... with the occurrence of coesite and stishovite in Vredefort rocks led Reimold and Gibson (1996) to conclude that the evidence "must be viewed as conclusive evidence for an impact origin of the Vredefort Structure". Recent analysis of satellite images by Phillips and others (1999) confirm that the structure is at least 250 km in diameter. Molengraaff would have been fascinated by these developments.

Molengraaff first visited Indonesia with an expedition to investigate Western Borneo (now West Kalimantan) in 1893 to 1894. This was more in the nature of pioneering work than his stint in South Africa, since the area was for the most part covered by primary equatorial forest, sparsely inhabited by native "dayak" tribes, and very little was known of the geology. The original intention to traverse Borneo from east to west had to be modified because of tribal hostility, and he continued the work southwards instead. His work was mainly in the valley of the Kapuas, the greatest river of Borneo (1143 km long, as compared to the Rhine at 1320 km). He traversed the rivers by launch and prau with a few side trips to prominent hills. He published his results in 1900 as a massive volume with an atlas of maps as Geologische verkenningstochten in Centraal Borneo (1893-94), succeeded in 1902 by a revised English edition, Geological explorations in Central Borneo (1893-94). The first part of the text consists of a detailed day-by-day account of his travels and observations (with many photographs of geological and ethnographic interest), and a second part of a more integrated discussion of the geology. The Atlas contains detailed geological maps of the rivers that he traversed, and sections across West and South Borneo.

The river traverse maps are excellent in their accuracy and detail. The most interesting and problematical parts were towards the north, where a thick steeply dipping pile of greywacke and slaty shale was named by Molengraaff the Oude Lei Formatie (Old Slate Formation), correlating with the OSF of Sumatra. This was in contact to the south with the most interesting group of rocks in Borneo, consisting of radiolarian cherts associated with lavas and gabbro, which M named the Danau Formation (Danau=Lake, after the great seasonal lakes in a depressed area of the upper Kapuas Valley). Molengraaff correctly interpreted the cherts as indicating deep sea conditions, and the gabbroic rocks as being intruded as sills. He arranged for the radiolaria to be determined by Hinde at the British Museum, the results being included as an elaborately illustrated appendix which itself became a paleontological classic study. Hinde concluded that the

Radiolaria are probably Jurassic (studies in recent years indicate mid-Cretaceous). Here Molengraaff made a major but understandable mistake: because of the intense dynamic metamorphism of the Old Slates, he concluded that these are older than the Danau, in spite of some indication to the contrary, notably a few occurrences of nummulites in float boulders within the area of Old Slates. Controversy about the age of the Old Slates rumbled on among Dutch geologists in the late 30s, but now they are regarded with better but still meager paleontological evidence as part of the great wedge of the Rajang Super Group, Upper Cretaceous to upper Eocene, which extends NE through much of Kalimantan, Sarawak to Sabah. The origin of this huge wedge and its relation to the Danau Formation is still by no means certain. The junction is marked by a melange belt, and is probably a major tectonic suture.

In 1901 Molengraaff made a field investigation of the geology and gold deposits in north Celebes (Sulawesi)and after having been appointed to the professorship in Delft he led an expedition to Timor and some neighboring islands in 1910-11. His map of the small island Leti was (in 1976) still the only geological map and the best topographic map of the island.

Molengraaff's subsequent work was more in the nature of interpretation rather than original fieldwork, and he published useful papers on deep-sea deposits (following on from the Danau Formation work), on coral reefs, and on the Pleistocene topography of the Sunda Shelf. As was likely for someone who had worked in South Africa, he took a positive view of Wegener's Theory of Continental Drift, notably at the Symposium of the American Association of Petroleum Geologist Symposium in 1925, at a time when this was discounted by many leading geologists. Our society recognized the quality of his work by the award of the Wollaston Medal in 1936. Molengraaff deserves to be better known, and I was glad to learn, in the course of preparing this talk, that he has found a worthy biographer in Professor Frederick van Veen of Delft University, happily present here this afternoon.

Selected references

A. General

- Martin. K. 1916 Prof. Dr. G. A. F. Molengraaff. Eigen Haard 14 October 1916, No .42, Amsterdam
- Umbgrove, J. H. F. 1942 In Memoriam Prof. Dr G. A. F. Molengraaff. Geologie en Mijnbouw, 4e Jaargang no. 3, 33-38.

B. South Africa

- Boon, J.D. and Albritton Jr. 1936 Meteorite craters and their possible relationship to "cryptovolcanic structures". Field and Laboratory 5, 53-64.
- Daly R.A. 1947 The Vredefort ring structure of South Africa. Journal of Geology, 55, 125-145.
- Geonews 1999 A greater crater. Geoscientist, 9, 9, September 1999, p 8.
- Hall, A.L. and Molengraaff, G.A.F. 1925 The Vredefort Mountain Land in the Southern Transvaal and the northern Orange Free State. Verhand. Kon. Akad. V. Wet. Amsterdam, Deel 24, 3, 1-183.
- Haughton, S.H. 1969 Geological History of Southern Africa. Geological Society of South Africa.
- Kamo, S.L., Reimold, W.U., Krogh, T.E. & Collison, W.P. 1996 A 2.023 Ga age for the Vredefort impact event and a first report of shock metamorphosed zircons in pseudotachylitic breccia and granophyre. Earth and Planetary Sciences Letters 144, 369-387.
- Phillips, M.E., Bussell, M.A., McDonald, I., Hart, R.J. & Andreoli, M.A.G. 1999 A remote-sensing and geological investigation of the Vredefort Impact Structure (South Africa) using Landsat Thematic Mapper Imagery. Meteoritics and Planetary Science, 34, 4, Supplement A92-93.
- Reimold. W.U. & Gibson R.L. 1996 Geology and evolution of the Vredefort Impact Structure, South Africa. Journal of African Earth Sciences 23, 125-162.
- Schand, S.J. 19177 The pseudotachylite of Parijs (Orange Free State) and its relation to "trap-shotten gneiss" and "flinty crush-rock". Geological Society of London, Quarterly Journal 72, 198-221 (Read March 22nd 1916).

- Tankard A.J. et al. 1982 Crustal evolution of Southern Africa. Springer-Verlag.
- V an Veen, F. R. 1997 Gustaaf Molengraaff en de Expeditie naar Centraal Borneo in 1894.Jaarboek van de Mijnbouwkundige Vereeniging te Delft, 21sr Lustrum, 263-279.

C. Indonesia

- Basir Jasin & Haile, N.S. 1993 Some Radiolaria from the chert block of Lubok Antu Melange, Sarawak. Warta Geologi 19, 5, 205-210.

- Molengraaff, G.A.F. 1900 Geologische verkenningstochten in Centraal Borneo (1893-94). E.J.Brill, Leiden.
- Molengraaff, G.A.F. 1902 Geological explorations in Central Borneo (1893-94). English revised edition. Leyden and Amsterdam, Society for the Promotion of the Scientific Exploration of the Dutch Colonies. E.J.Brill & Kegan Paul, Trench, Trubner & Co.
- Molengraaff, G.A.F. 1902 Ueber die Geologie der Umgegend von Sumalatta auf Nord-Celebes und über die dort vorkommenden goldführenden Erzgänge. Zeitschrift für prakt.Geologie 249-258.
- Molengraaff, G.A.F. 1909 On oceanic deep-sea deposits of Central-Borneo. Proc. Kon. Akad. v. Wetensch. 141-147.
- Molengraaff, G.A.F. 1912 On recent crustal movements in the island of Timor and their bearing on the geological history of the East Indian Archipelago. Proc. Royal Acad. Sciences, Amsterdam 15, 224- .
- Molengraaff, G.A.F. 1916 Geographische en geologische beschrijving van het eiland Letti. Jaarboek van het Mijnwesen in Nederlandsche Indië 1916, 1, 1-87.
- Molengraaff, G.A.F. 1914 Hoofdtreken der geologie van Oost Borneo naar aanleiding der reizen van Prof. Dr Niewenhuis en anderen. [Major aspects of the geology of East Borneo following the journeys of Prof Niewenhuis and others]. Geol.-Mijnbouwkundig Genootschap Ned. en Kolonieën, 1912-1914, 1, Verslagen der Geologische Sectie 175-179.
- Molengraaff, G.A.F. 1915 De geologie van het eiland Letti, met medewerking van F. Broili, H. A. Brouwer, B. G. Escher, C. A. Haniel en R. J. Schubert. Nederlandsche Timor-Expeditie 1910-1912, Deel 1 (met Atlas) Leiden 1915 (Jaarb. Van het Mijnwesen Jaarg. 43, Verhand. 1).
- Molengraaff, G.A.F. 1916. On the occurrence of nodules of manganese in mesozoic deep-sea deposits from Borneo, Timor, and Rotti, their significance and mode of formation. Proc. Royal Acad. Amsterdam 18, 415-430.
- Molengraaff, G.A.F. 1921 Modern deep-sea research in the East Indian Archipelago. Geogr. Jour., 57, 95-121.
- Molengraaff, G.A.F. 1922 De Geologie der zeeën van Ned. Oost-Indië [The geology of the seas of the Netherlands East Indes]. in De Zeeën van Ned. Ost-Indië edited by Kon. Ned. Aadr. Gen. (English translation in Proc. IVth Pan Pac. Sci. Congress, Java, 1929, IIB, 989-1008, 1010-1021).
- Molengraaff, G.A.F. & Weber, M. 1919 On the relation between the Pleistocene glacial period and the origin of the Sunda Sea (Java- and South China-Sea), and its influence on the distribution of coral reefs and on the land- and freshwater fauna. Proc. Royal Acad. Amsterdam 23, 395-439.

Eric Robinson: The Geologists' Association in the field

Meeting rocks in the field makes geology come alive as a science, and for amateurs or beginners field experience is vital. In their wisdom, the founders of the GA wrote that there should be field excursions, and so the inaugural members went to Oldhaven Gap, Herne Bay and Reculver, Kent. In the history of the GA reports of many long excursions appear in print but many were simply ½ day excursions and only fleeting records exist. At the time they started to look at London just London was expanding with the laying of water and sewerage systems, and the coming of the railways adding vital exposures. Primrose Hill cutting was a venue, as was Archway cutting between 1860 and 1880. Karl Marx collected amber at Highgate - but not as a GA member!. Later the London Clay Club became the Palaeontographical Society. The value of temporary exposures was illustrated by the section of railway from Croydon to Oxted (Surrey), which never reached the Chalk of the North Downs. It was written up in 1870 by Caleb Johnston as pamphlets but never incorporated into a bulletin. Excursions were often announced to the members as single page sheets, but many of these have not been kept. The GA was quick to see the benefits of cheap travel, and a trip to Boulogne was organised. In this period, 1860-70, the GA was active in campaigning for office/shop workers to be able to take part (most had to work on Saturdays). A little later, in 1890s, the GA involved the

growing number of cyclists, including J.F.Blake, in some of its excursions, and later still there were excursions starting in London and going by charabanc to a site; pickup and put-down was in Trafalgar Square! Excursions became such a part of the GA that in 1908 (for the 50th Anniversary of its founding), authors were asked to bring accounts of the sites together in one volume; today it is the "Geology in the Field" series.

Excursions became rather more disciplined. Prof. Fearnsides took one to North Wales; it was one of the first to be preceded by in depth information. The pattern continued in the 1920s and 1930s, and field-meeting reports make a greater part of the published material, maybe up to 30%. By making it available, leaders could look up what had been published, and also routes to be taken. In 1958 David Williams, as then President for the 100th Anniversary celebrations, initiated the Centenary Guides, which were small slim buff volumes dealing with University Towns. Thirty-two were planned. In recent years, regional societies have caught the habit, and they offer good accounts of their areas. This makes it easy for people to go and look at the local geology, and guides have added much interpretation to what might be found. Simplicity is the key. There are still lots of people at the starting point of geology. Most recently, the GA has initiated overseas trips with visits to Tunisia, Tibet , Texas, and.....Skye, and they remain always aware of the amateur and beginner.

DESIGN IN EARLY 19TH CENTURY GEOLOGY.

If anyone can think of any examples of geologists speaking of design in geology, other than that of the earth being providentially designed for human habitation, e.g. considering the "Design " of a river or other geological feature in the style of Paley on animal structure or of course Buckland on Megatherium etc, can they let me know.
To me Buckland is the obvious place to look but have found no examples of what I want. As far as I can see Design is restricted to either a general view that earth is designed for humanity to live, or detailed design in living forms. This is a tall order but I am wanting to force neo-Creationists to ask in what way a glacial moraine, for example, is "Designed".

Michael Roberts, Chirk Vicarage, Trevor Road, Chirk, Wrexham LL14 5HD, Wales United Kingdom. Phone 01691-778519.

Beaten to the punch.....

Archaeologists and local residents of Finningham, Suffolk, last year marked an interesting and important bi-centenary with the erection of a plaque in the village church to John Frere. Frere has never been considered an archaeologist in the modern sense and rarely rates mention with his contemporary early geological acquaintances. Usually he is referred to as an antiquarian in the broad 18th century sense of somebody generally interested in historic artefacts.

He was a wealthy Suffolk landowner and MP, his family having been settled in north Suffolk and south Norfolk for many generations. He had a life-long interest in the natural history of his surroundings and had been elected a Fellow of the Royal Society in 1771. Between 1797 and 1799 he obtained from the brickearth pits at Hoxne, north Suffolk, a

number of worked flints from interglacial lacustrine deposits and recognised them as being human artifacts of considerable antiquity. They were not only the undoubted work of man but had been made by a race "not of the present world". He also recognised that the tools were not found just anywhere but came from particular horizons in the section exposed.

He published his work in vol. 18 of Archaeologia in 1800, and thus became the first to publicly identify these flint tools as being of human origin, and also to state that they provided evidence of a longer ancestry for man than had hitherto been thought.

The plaque, located on the north wall of Finningham Church near the chancel step, is carved from a substantial oval block of slate some 2 feet tall by 18 inches wide and is inscribed:

John Frere FRS, FSA, who from his discovery at Hoxne was the first to realise the immense antiquity of mankind
1740-1807

Above the inscription is a replica of one of the tools that he found with the words:

Replica of a flint hand-axe found at Hoxne 1797

Possibly it was too difficult to fit a real hand-axe - a pity because the replica looks just what it is - a replica.

The moral of this note is that geologists could do a lot worse than take a lead from the archaeologists to improve the public's perception - all it needs is a little determination.

John Martin.

New Journal of interest...

The *"Journal of the History of Oil Industry"* will have its first issue published in the year 2000. The publisher is the Drake Well Foundation in Pennsylvannia. Dr. Gerald M. Friedman will serve as the Editor of the journal and would be interested to hear from those who have anything they would like to contribute to the journal. His address is Rensselaer Center of Applied Geology ,(c/o Brooklyn College of the City University of New York, Brooklyn, New York), 15 Third Street, P.O. Box 746, Troy, NY 12181-0746

CONFERENCE ON THE HISTORY OF GEOLOGIC PIONEERS

This meeting will be held in North America, the homeland of our geologic pioneers, from August 3-5,2000, and will combine theme-oriented and volunteer papers with visits to their favorite exposures.

The field trip will include ceremonies (memorial plaques will be installed at several sites) at the graves of founders of the Geological Society of America, the American Association for the Advancement of Science, and the American Association of Petroleum Geologists.

The meeting is being hosted by the Rensselaer Center of Applied Geology located at 15 Third Street in (downtown) Troy, New York (see below). This center has been named in honor of Jeremias Van Rensselaer (1783-1871), respected geologist whose book *"Lectures on Geology"* (1825) has popularized the science.

Call for papers: Please send title for theme-oriented or volunteer paper/poster to:

Dr. Gerald M. Friedman, Rensselaer Center of Applied Geology , (c/o Brooklyn College of the City University of New York, Brooklyn, New York) 15 Third Street, P.O. Box 746, Troy, NY 12181-0746 (e-mail: gmfriedman@juno.com; Fax: 518-273-3249)

Coming soon ...

Simon Knell. *The Culture of English Geology, 1815-1851: A science revealed through its collecting*, Ashgate, Aldershot/Vermont.

Seven years in the making, this is a book of life, death and immortality, of ambition, rivalry and jealousy, of politics and social ambition. It rethinks the way we view the history of geology in its most popular phase. Here the fossil becomes a common currency linking the worlds of gentleman geologist, provincial philosopher and artisan. Major figures, such as William Smith and John Phillips, are seen in new light. Institutions, like the provincial philosophical societies, become central to understanding why the new science became so popular. Never merely about natural knowledge nor simply a fashion, this popularity was indicative of much more prevalent and significant social desires. In some 400 pages the factions of geology are explored, its provincial manifestations disentangled, its museums, collector networks, gift giving, fieldwork and marketplace are all revealed as part of an extremely rich and complex cultural world. Combining geology in London with detailed studies of provincial geology in Yorkshire and the Geological Survey in Devon and Wales, this book reveals how geology was undertaken, and how and why it changed. It ends by looking at how the science wished to be seen and how this contributed to notions of an heroic age.

...and finally

Contribution to the Newsletter

Members have asked whether they can make contributions to the Newsletter by bankers' Standing Order, a method pf payment that avoids postal expense, cheque writing and memory failure. The short answer is yes! A form to set up a standing order on your bank account in the United Kingdom is provided below. **The HOGG acount regrettably cannot handle Direct Debiting.** Please send your completed Standing Order form to the HOGG Treasurer (John Fuller, 2 Oak Tree Close, Rodmell Road, Tunbridge Wells, Kent TN2 5SS). **DO NOT SEND IT TO YOUR BANK** otherwise the Treasurer has no way of knowing you intend making payment by this method. The Treasurer will send the form to the member's bank, and for that to be done a **COMPLETE BRANCH ADDRESS** (including the sort code number) on the form is essential. For those continuing to contribute by cheque, please make cheques payable to "History of Geology Group" and send them **to John Fuller (Treasurer), c/o The Geological Society, Burlington House, London, WV1 0UJ.**

Banker's Standing order for HOGG Members

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5. Instruction to your bank manager:

Please pay by standing Order on the above named account, in favour of the History of Geology Group of the Geological Survey (Girobank Account no. 14 665 9406, Sort Code 72-00-00) the sum of Seven Pounds annually beginning on January 1st 2000, and annually thereafter until terminated by me in writing.

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