Saturday 21st November 2009 – Darwin and the Voyage of the Beagle

10.30 – 11.15	Darwin's Welsh Geology, Reverend Michael Roberts, Lancaster
11.15 – 12.00	Charles Darwin (1809-1882) – A Mercian 'Glacial' Geologist, Professor Peter Worsley, University of Reading
12.00 – 14.15	Lunch and Visit to the Darwin Exhibition in the Manchester Museum
14.15 – 15.00	Charles Darwin: Gentleman Geologist aboard H.M.S. Beagle, Dr. Robert Callow, University of Manchester
15.00 – 15.30	Coffee Break
15.30 – 16.15	The Beagle Collection as a Collection of Geological Objects: Acquisition, Usage and Continuing History, Dr. Lyall Anderson, University of Cambridge
16.15 – 17.00	On the Geological Origins of Darwinian Theory: Charles Lyell, Charles Darwin and Alfred Russel Wallace, Professor Jon Hodge, University of Leeds

H.M.S. Beagle set sail from Falmouth on the 27th December 1831 bound for South America, where it was to conduct the second leg of a coastal survey for the Admiralty. On board was the young naturalist, Charles Darwin, equipped with microscopes, collecting equipment and a library of reference books. Darwin had accepted the invitation of Captain Fitz-Roy, and the voyage would take him over the Atlantic to Brazil, Argentina, the Falklands, Patagonia, Tierra del Fuego, Chile, then across the Pacific to New Zealand and Australia via the Galapagos and other islands, before returning home to Portsmouth on 2nd October 1836.

During the voyage Darwin was to have many adventures – discover large fossil mammals, ride with gauchos, and witness armed insurrection in Argentina, encounter savages and wonder at glaciers in Tierra del Fuego, see volcanic eruptions and survive a large earthquake in Chile. The journey was to be the major formative event in Darwin's career. The large number of rock, fossil, plant and animal specimens he collected would provide much material for further investigation on his return home, resulting in several geological tomes and, ultimately, the '*Origin of Species*' and the '*Descent of Man*'.

Darwin's Welsh Geology
Reverend Michael Roberts, Lancaster

In 1991 Secord observed that Darwin was the best-trained young naturalist in 1831. Much was due to his Welsh connections both direct and indirect.

Darwin had a three-way connection with Wales - first through his own frequent visits, secondly through Henslow and thirdly Sedgwick, who in a few weeks created a fine geologist.

From a child Darwin visited Wales and explored the countryside frequently observing the natural history. What he learnt was of two-fold benefit for the *Beagle* voyage and subsequent work. He learnt to cross wild country by horse or foot, whether a gentle horseride near Welshpool or his serious hikes in the late 20s, culminating in his four-day trek from Cwm Idwal to Barmouth in 1831, which is no mean feat today. This prepared him for his *Beagle* treks. Alongside this was his natural history, which took precedence to his official studies, and gave him a holistic view of natural history from beetles to the poor birds on Bird Rock. This effectively gave him several annual fieldtrips alongside his work in Edinburgh, Shropshire and Cambridge.

For the student "who walked with Henslow" most emphasis is given to natural history as Henslow was a botanist. However Henslow was a highly skilled geologist as his 1822 memoir on Anglesey shows.

Darwin took this memoir on the *Beagle*, annotated it, drew comparisons with South American geology and wrote a private paper on it. Darwin made two pages of notes on Anglesey rocks and almost certainly went round Anglesey with Sedgwick armed with the Memoir.

The greatest Welsh connection was his geological trip with Sedgwick, which probably lasted 18 days. It gave him a grounding in all field geology, especially, on igneous rocks. Reading his notes in order shows the rapid progress and those made on his own from Idwal to Barmouth show considerable perception.

Many of his skills learnt in Wales were used on his voyage, especially on igneous rocks from the Cape Verde to the Galapagos and on Falklands geology. His Welsh experiences were never far away. This was of more importance than his reading of Lyell.

Darwin's last field-trip in 1842 demonstrates his perception and willingness to change his mind over glaciation, having initially rejected the theories of Charpentier and Agassiz. It is fitting that this trip formed an interlude during his writing the first essay on Natural Selection.

Charles Darwin (1809-1882) – A Mercian 'Glacial' Geologist
Professor Peter Worsley, University of Reading

Charles Darwin was born at 'The Mount' in Shrewsbury, Shropshire on 12th February 1809. His illustrious grandfather – Erasmus Darwin (1731 - 1802) – was born in Elton Hall, Elton, Nottinghamshire and the family line can be traced back to William Darwin (deceased before 1542) of Marton, Lincolnshire. Hence the family were of true Mercian stock.

Darwin's opportunity of sailing in the Beagle was the result of the suicide of Lieutenant Pringle Stokes in 1828 at Puerto Hambre on the Straits of Magellan during the first South American surveying voyage of the Beagle (1826 - 1830). Robert Fitz-Roy (1805 - 1865), who alas was to later take his own life, replaced Stokes as commander and in an attempt to control theft by the native Fuegians he took hostages. In order to return the hostages to their native home after two years of 'Christian education' in Britain, Fitz-Roy was eventually able to gain Admiralty approval for a second surveying voyage by the Beagle (1832 - 1836) and authorization to take a naturalist of his choosing.

After attending Shrewsbury School, Darwin spent two years at Edinburgh University where he gained his first formal geological education by attending a natural history course given by the Wernerian Robert Jameson (1774 - 1854). Thereafter he attended Cambridge University to read for an ordinary BA degree (not theology as is often incorrectly asserted) and during that time became acquainted with Adam Sedgwick, the Professor of Geology. During the summer prior to embarking on the Beagle, Darwin had some bedrock field mapping training with Sedgwick in North Wales but they were oblivious to the imprint of glaciation on the landscape. Fitz-Roy had ensured that a copy of the first volume of Charles Lyell's '*Principles of Geology'* was in the Beagle library and this plus the two volumes published during the voyage greatly influenced Darwin's approach to field geology.

Darwin became aware of anomalous clasts (erratics) before he left school, e.g. the Bellstone in Shrewsbury. In Tierra del Fuego, along the northern shore of the Beagle Channel he observed 'immense glaciers' and a number of these were subject to terminal calving where they entered the sea creating ice bergs. He appreciated the difference in landform and sedimentological response between fluvial and glacial processes. However it was only after returning to Britain that he had the chance to read the then contemporary literature on the developing 'Glacial Theory'. He was clearly impressed by the paper by Jens Esmark (1763 - 1838) when he came to write his '*Journal and Remarks'* for the narrative of the second surveying voyage.

In 1838 he undertook a new field study of the Glen Roy shorelines and argued for a marine origin. In this he was undoubtedly influenced by the Neotectonic marine terraces he had examined at Coquimbo

in central Chile. Later he considered his Glen Roy interpretation as 'his greatest blunder'. In the Pacific he encountered coral atolls and his subsidence hypothesis has withstood the test of time. The heated debate over the postulated glaciation of Britain in 1840 at the Geological Society led him to undertake what was to be his last geological fieldwork in North Wales in 1842. Undoubtedly his experience of the glaciated landscapes of Tierra del Fuego enabled him to immediately see the magnificent glacial landforms and allied block transport. As a result he became one of the first British geologists to embrace the land ice hypothesis although his support for the then conventional wisdom of the 'Great Submergence' accounting for ice berg transport of erratic blocks outside mountainous terrain was retained until the 1860's.

Although Darwin concentrated on evolutionary biology after ca. 1850, he retained an interest in geology. During a visit to his eldest son in Southampton in 1876 he noted disturbances in superficial terrace gravels and 'the larger stones standing on end' associated with a general vertical clast fabric. He entered into correspondence with James Geikie about their significance as cold climate phenomena.

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Lunch Break and Visit to the Darwin Exhibition, The Manchester Museum

A generous two and a quarter hour break will allow time for lunch, before or after visiting '*The Evolutionist: A Darwin Extravaganza*' exhibition at Manchester Museum. The museum is on the opposite side of Oxford Road to the Williamson Building – the entrance is through the arch and then to the right across the courtyard. Lunch can be obtained in Café Musé, within the museum, or at one or two other places nearby. The museum exhibitions include: -

'*Charles Darwin: Evolution of a Scientist'* – Discover who Charles Darwin was and the impact of his work. This exhibition showcases fantastic objects - some collected by Darwin himself – and illustrated in a graphic novel style (Ground Floor, until 30th August 2010).

'*In Darwin's Footsteps*' – A photographic installation of South American landscapes and wildlife which Darwin saw on his travels, by local photographer Ben Hall (Third Floor, until 31st January 2010).

'*Evolution Revolution*' – Celebrate the 150th anniversary of the publication of Charles Darwin's book, *On the Origin of Species* - about Darwin's theory of evolution by natural selection. Find out why this was one of the biggest, most important and most controversial ideas of all time (Saturday 21st November only).

There is also a large Fossil Gallery inside the Museum.

Charles Darwin: Gentleman Geologist aboard H.M.S. Beagle
Dr. Robert Callow, University of Manchester

As a biologist, I have long appreciated the significance of the second voyage of HMS *Beagle* in fostering Darwin's ideas on evolution. Until recently, however, I was largely unaware of its importance in relation to Geology. Darwin's biological discoveries had to await his return to England in 1836 and the deliberations of experts such as Richard Owen and John Gould who examined his specimens. By contrast, his geological discoveries were very largely concluded during the voyage and his deductions were arrived at with very little expert assistance, apart from readings of Charles Lyell's *Principles of Geology* which Darwin often discussed with the ship's captain Robert Fitzroy. Fitzroy had become aware of the importance of Geology during the first voyage, when his compass bearings had been distorted during the passage around Tierra del Fuego. Fitzroy assumed that the local

mountains must contain iron ore and resolved to bring a geologist with him if he ever returned. In the event, he was able to purchase the first volume of Lyell's *Principles*, newly published on his return to England in 1830, not only for himself but also for his companion the young naturalist Charles Darwin. Darwin himself had received very little training in geology, other than a short expedition to North Wales in the company of Adam Sedgwick and possibly in the form of advice from his mentor John Henslow. Both Henslow and Sedgwick, although professors at Cambridge, were 'gentlemen of the cloth' and neither approved of Lyell's views as expressed in the *Principles*. Henslow specifically warned Darwin 'on no account to accept the views therein advocated'. Unfortunately for Henslow, his continuing advice could only arrive by letter and then only after intervals of several months. Although the two men did not meet for five years, Lyell had a strong influence on Darwin because the *Principles* was always to hand. Indeed, by the time the two did meet in 1836, there was probably only one man living who knew more about the *Principles* than Darwin and that was Lyell himself.

'The geology of the voyage of the Beagle' was published in three parts: *The structure and distribution of coral reefs* (1842); *Geological observations on the volcanic islands visited during the voyage of H.M.S.* Beagle (1844) and *Geological observations on South America* (1846). Darwin furnished these reports with an abundance of technical observations which are no doubt of interest to specialists and which are likely to have benefited from expert opinion given after his return to England. In this short talk, we shall concentrate on dramatic conclusions reached by a young inexperienced geologist, directly inspired by the evidence before him. We can assess the excitement which these caused from the descriptions in Darwin's pocket-books, his 'commonplace journal' now usually referred to as the *Beagle Diary*, and in his letters to his sisters and to Henslow. On 22nd September 1832, Darwin, Fitzroy and Second Lieutenant Bartholomew Sulivan inspected the cliffs west of Buenos Aires at Punta Alta. Here they perceived fossilised bones of giant animals which had until recently roamed the Pampas. As Fitzroy was later to remark, "Notwithstanding our smiles at the cargoes of apparent rubbish which he [Darwin] frequently brought on board, he and his servant [Syms Covington] used their pick-axes in earnest and brought away what have since proved to be the most interesting and valuable remains of extinct animals". On 20th February 1835, Darwin and Covington were ashore near Valdivia, when a major earthquake struck the region of Concepcion 200 miles to the north. For the first time in his life, he felt the Earth move beneath him. On 4th March, the Beagle reached the scene of devastation at Concepcion. Fitzroy gave a detailed and dramatic summary of the accounts of eye-witnesses of the tsunami which struck the nearby port of Talcahuano in the wake of the earthquake.

On the frontispiece of the first volume of his *Principles of Geology*, Lyell had used the ruins of the Temple of Serapias at Puzzuoli near Naples to demonstrate downward and upward movements of land which had taken place over a period of 1200 years. Darwin now discovered that the region of Concepcion had risen between ten and twenty feet in a matter of days. By 20th March, Darwin, standing at 13,200 ft on the summit of the Peuquenes ridge in the Cordillera mountains, observed fossils of marine molluscs buried in deposits which had once been at the bottom of a deep ocean but had since been elevated more than 14,000 feet. On returning to Valparaiso via the Upsallata Pass on the eastern side of the Andes, Darwin found some fossilised trunks of trees resembling modern Araucarias (Monkey Puzzles). Mindful of the great sedimentary deposits on the plains of Patagonia, which even Fitzroy had doubted could be caused by forty days of biblical flood, Darwin felt inspired to comment "I saw the spot where a cluster of fine trees had once waved their branches on the shores of the Atlantic, when that ocean (now driven back 700 miles) approached the base of the Andes".

A year later, Darwin was on the other side of the globe, where Fitzroy was extending his chain of chronometric measurements in the Keeling (otherwise known as Cocos) Islands. Here his earlier experience of mountains that rise and fall, combined with his understanding of the life of corals, suggested an explanation for the formation of coral islands, atolls and barrier reefs. This explanation was at odds with that suggested by Lyell but soon came to be universally accepted. At twenty seven, the young geologist had come a long way. Later in his official report on the voyage, he was to note "Daily it is forced home on the mind of the geologist, that nothing, not even the wind that blows, is so unstable as the level of the crust of this earth". Darwin's return to England brought fame, friendship

with Lyell, membership of Learned Societies and above all self-confidence. In the main, this confidence was soundly based in objectivity and independence of mind. It was rarely misplaced. Ironically, the first notable exception arose from his insistence that the famous Parallel Roads of Glen Roy, which he visited in the summer of 1838, represent beaches formed around earlier marine incursions. Darwin's interpretation, which he shared with Lyell, was at odds with that of John MacCulloch and Thomas Lauder who had postulated the existence of a series of freshwater lakes. It was, moreover, at odds with a distinct lack of evidence in the form of marine shells. Time and an improved knowledge of glaciation vindicated the Highlanders but by then, although he never lost his fascination with Geology, Darwin's attention had turned to the great obsession of his life the transmutation of species.

The Beagle Collection as a Collection of Geological Objects: Acquisition, Usage and Continuing History

Dr. Lyall Anderson, University of Cambridge

Charles Darwin (1809 - 1882) was an avid collector from an early age. A childhood spent in the geologically varied county of Shropshire, two years in Edinburgh and environs and accompanying Adam Sedgwick on fieldwork in North Wales all added to his growing geological experience. The strong influence of Charles Darwin's teachers and mentors at the University of Cambridge can be detected in the language and style of his geological field notebooks. But as we examine the notebooks in detail, we gain a sense of how many other earlier influences shaped the ideas and thinking of the developing field geologist.

The first volume of Charles Lyell's '*Principles of Geology'* provided Darwin with a framework into which he found he could fit his ongoing field observations. That said, the other two volumes of the '*Principles'* only arrived with Darwin piecemeal after their publication dates in Britain (1832 and 1833) and after their outward sea voyages to join H.M.S. Beagle. Darwin spent two extended field seasons in the ore fields of Chile (1834 and 1835) and his notebooks from this time reveal careful observation and early theorizing as to the importance of cross-cutting and multiple event brecciation in the formation of ore-bearing vein systems. These observations were a mix of his personal experience and his conversation with miners and mine owners in the mineral exploitative industries of Chile. His observations stand up well to what we might know and recognise as stockwork ore bodies associated with Porphyry Copper deposits. Darwin's thoughts on geologically 'young' gold deposits brought him into direct disagreement with Roderick Murchison at the Geological Society of London in 1849.

On his return to England he set about finding subject specialists capable of researching the collections that he had assembled whilst voyaging for almost five years onboard H.M.S. Beagle. Although much of his fossil material was 'farmed' out to others for formal description (including the then Hunterian Professor Richard Owen), he retained the majority of his rock and mineral collections long after publishing his few formal geological works (such as *Geological Observations on South America* (1844)). Collections assembled during a person's lifetime often take on an identity of their own after the death of their collector, and so it was with Darwin's geological objects. The geological samples now held by the Sedgwick Museum of Earth Sciences only arrived back in Cambridge in January 1897 some sixty years after its initial assembly, fifteen years after Darwin's death and shortly after the death of his widow Emma. Here it formed a significant addition to the Sedgwick Memorial Museum opened in 1904. A preliminary catalogue of the collection was prepared in 1907 by the renowned petrologist Alfred Harker (1859 - 1939), who began the task of thin-sectioning and providing more up-to-date identification of Darwin's rocks. Subsequently, the petrologist Cecil E. Tilley (1894 - 1973) used the hand specimens and derivative thin-sections in his studies of the St. Paul's Rocks dunites and mylonites. Labelling and handwriting styles on the thin sections help chart various workers research interests (published and unpublished) in the Beagle collection rocks up to the present day.

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On the Geological Origins of Darwinian Theory: Charles Lyell, Charles Darwin and Alfred Russel Wallace

Professor Jon Hodge, University of Leeds

This November, we here in Manchester, like many other people around the world, are gathered together to mark the day of publication -- almost exactly a century and a half ago on the twenty-fourth of the month -- of Darwin's book: *On the Origin of Species* (1859). Darwin had written this book in just thirteen months starting the summer before. That summer he had been shaken to receive a letter from a younger English naturalist, writing from the Dutch East Indies and known to him only from a few earlier letters and from his publications. He was shaken by this letter because enclosed with it were several handwritten pages sketching a theory about the causes of the formation and adaptation of species in an irregularly branching tree of descent. And this theory, Alfred Russel Wallace's theory, Darwin was appalled to see, was essentially the same as Darwin's own 'theory of 'natural selection,' the theory that Darwin himself had first arrived at twenty years before but had never yet made public in any lecture, book or paper. To do justice to both Darwin and Wallace, friends of Darwin's arranged for some of Darwin's unpublished texts, together with Wallace's sketch, to be presented as a joint communication to the Linnean Society of London and then quickly included in its printed proceedings.

Over the coming years, starting with Darwin and Wallace themselves, the question has often been raised: Why was it that these two men, quite independently of one another, came up with such strikingly similar theories? Not surprisingly, the best answers to this question have required the lives and the works of the two men to be compared in many and detailed ways. No simple answer, no answer citing just a single common influence, can meet all the challenges the question poses for our biographical and historical inquiries. However, suppose we ask whether there was any one common influence that was so decisive that it allows us to see how other quite different common influences could also have contributed in very diverse ways to the independent convergence on that same theory? Ask that question, and then, my paper will argue, we may do well to answer: Yes, there was, and it was Charles Lyell's reformation of geology, especially including, as it did, his reformation of biogeography.

In Lyell's account all the changes going on at the earth's surface at any period in the past (since the oldest known fossil-bearing rocks were laid down, then the Carboniferous rocks) are going on at every other period including the present and future. On the physical side, mountain ranges, for example, are being formed and destroyed slowly over eons. On the organic side, species are becoming extinct and others are being created all the time. Hence, then, Lyell's reforming of biogeography: through his insistence that what areas of land have been accessible and habitable for any species has changed in the vast time during which the species extant today have been coming into existence, one at a time and not in one big batch as other geologists seemed to presume. As for Lyell's view of species origins: he held that each new species is an independent creation, fixed in its characters, starting at a single place and that that place is determined only by adaptational considerations. So, the species originating in very different conditions will be very different in character and, conversely, any similarities among species that have originated in distinct areas must be due to common adaptations to common conditions in those areas. Now, it was these implications of Lyell's views that Darwin and Wallace came independently to reject. What is more, each of them concluded that it was often common ancestry not common conditions that best explained common characters among similar species. This fundamental, shared, independently arrived-at response to Lyell's views became the basis for a whole sequence of other, further independently reached conclusions. Or so, at least, I shall try to establish in the rest of this talk.

Further Browsing

General Information: -

http://en.wikipedia.org/wiki/Charles_Darwin -
http://en.wikipedia.org/wiki/HMS_Beagle
http://en.wikipedia.org/wiki/Voyage_of_the_Beagle
http://en.wikipedia.org/wiki/Second_voyage_of_the_Beagle
http://www.strangescience.net/darwin.htm
http://ww.darwinfoundation.org
http://roughguidetoevolution.blogspot.com/

You can access all of Darwin's books, papers and correspondence on-line at: -

http://darwin-online/org/uk
http://www.darwinproject/ac/uk

For Darwin Events: -

http://www.darwin200.org
http://www.open.ac.uk/darwin/