

In the Footsteps of Darwin

By Dr. Rob Wesson, USGS Emeritus, presented at the Colorado Scientific Society on February 15, 1918.

Abstract: Charles Darwin is famous for introducing the world to the theory of evolution, a concept that altered the way man's place in the world is viewed. However, what is *not* commonly known is that Darwin's role on the HMS Beagle was as a geologist with a mission to examine the land, not the flora and fauna. Darwin also produced seminal ideas and proofs of the dynamic nature of the Earth's crust. This is the story told in Rob Wesson's book, [Darwin's First Theory](#).

Dr. Wesson first became interested in Darwin's geological ideas while reading [The Voyage of the Beagle](#) on a vacation to Patagonia in 2001. Retracing Darwin's footsteps in South America and beyond, Wesson trekked across the Andes, cruised waters charted by the Beagle, hunted for fossils in Uruguay and Argentina, and explored sites of long vanished glaciers in Scotland and Wales. As he followed Darwin's path literally and intellectually, he experienced the land as Darwin did, engaged with his observations, and tackled the same questions Darwin had about our ever-changing Earth.

Short Biography: Rob Wesson early interest in mountains and glaciers led to a BS in earth science from MIT, and an MS and PhD in geophysics from Stanford University. His career in earthquake research with the U.S. Geological Survey (USGS) spans 4 decades, where he is currently a Scientist Emeritus. He has also written about science for a popular audience for the USGS and for Scientific American. In retirement, his research has turned to Chile where he is collaborating with a team exploring large earthquakes, tsunamis, and associated tectonic questions. This work has been supported in part by grants from the National Science Foundation.

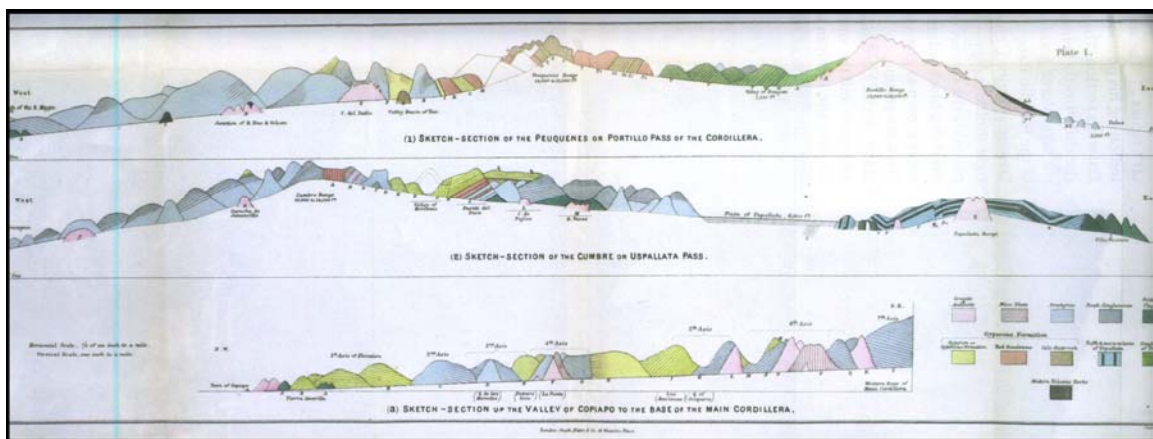
Darwin began his career studying medicine in Edinburgh. When these courses proved uninteresting to him, his father then sent him to Cambridge with the intention that he become a country parson. There he became acquainted with John Henslow, a wide spectrum naturalist and ordained Anglican clergyman, and Adam Sedgwick, another Oxford don and naturalist. In preparing for a proposed field trip to the Canary Islands with Sedgwick, Darwin obtained the Brunton compass of the day and practiced by measuring the strike and dip of his furniture and studying the geology of his home town of Shrewsbury. William Smith had delineated the stratigraphy of the English countryside using the fossils in rocks, but Sedgwick was interested in the time sequence of these rocks and coined the names Paleozoic and Cambrian.

Darwin was granted permission by his father to sail on the Beagle after much persuasion by the young man and one of his relatives. The trip had two purposes: to map the west coast of South America and to refine the longitudinal

meridians. Captain Fitzroy took a selection of chronometers for this second objective, and by the end of the trip had corrected the scale to within a few seconds of the correct time.

Following an initial stop at St. Iago on the Cape Verde Islands, the ship traveled to Brazil and then Patagonia, where Fitzroy determined to sail up the River Santa Cruz, an expedition which no European had done before. Whale boats were used for this purpose and Darwin observed the river terraces along the route, which he interpreted as being due to a gradual uplift of the land. Dr. Wesson repeated this trip in 2013 (without the whaleboats) and observed the river terraces capped by basalt and large boulders moved by water. Darwin inferred these rocks as having been deposited by icebergs when the sea level was higher.

After the trip up the Santa Cruz, the Beagle sailed around Cape Horn and along the coast of Chile, but lost one of its anchors which were vital for a survey ship. While Captain Fitzroy was finding a replacement in Valparaiso, Darwin disembarked at Concepcion in order to explore the Andes around Mendoza, which is now in Argentina. Dr. Wesson retraced Darwin's route, rediscovered the shallow water fossils that Darwin had found at high altitude, and examined Darwin's cross sections. While the maps show detailed and accurate geology, they also reveal that Darwin was not familiar with the concept of thrust folds.



Darwin's Cross Section

Contemporaneous with the Beagle trip, Maria Graham was sailing around Cape Horn in 1822. After a major earthquake she observed newly exposed shellfish and previously submerged shipwrecks due to a 3-4 ft uplift, and made a report to the Geological Society in London. (While Darwin was in Mendoza, Fitzroy observed on the island of Santa Maria upraised limpets and seaweed, and after hearing the testimony of the inhabitants decided that the island had indeed been raised 8 feet in the earthquake.) Nevertheless, George Greenough, the President of the Royal Society and a believer in gradual change to the earth's topography trashed Mrs. Graham's observations, saying there was not one incidence in the world where a non-volcanic rock had lifted due to an earthquake.

Charles Lyell had asked “Had the earth been shaped by great catastrophes in the distant past or were the processes that shaped still continuing?” Lyell used an engraving of the Temple of Serapis built in Italy, north of Naples, around the time of Christ as a frontispiece for his publication Principles of Geology. This ruin posed a riddle to these early naturalists as there was evidence of mollusks one third of the way up the columns. It obviously had not been constructed with tides lapping at its doors. Lyell suggested tectonic influences were involved.

The scheduled 2-yr voyage of the Beagle ended up lasting five years. Upon his return and after synthesize the effects of earthquakes, tsunamis, volcanic eruptions, and more, Darwin conceived his theory of subsidence and uplift, his first theory. His concepts on the vastness of time; the enormous cumulative impact of almost imperceptibly slow change; and change as a constant feature of the environment underlie Darwin’s subsequent discoveries in evolution.

When back in England, Darwin attended meetings of the Geological Society where arguments were encouraged. He also attended the Athenaeum, where he read essays by Malthus on population. Darwin decided to test his ideas on uplift closer to home and traveled to Glenroy in Scotland. The glen at Glenroy featured lines along the sides of the hill which were thought to be ancient shorelines. Darwin proposed that these shorelines were formed when the sea level was much higher, and he published a paper on the topic at the Royal Society. A few months later the renowned naturalist Louis Agassiz suggested the lines were formed by glaciers damming the valley. Although Darwin is quoted as saying, “Geology is a capital science, as it requires nothing but a little reading, thinking and hammering” it took him two decades to accept this alternative theory.

Dr. Wesson described visiting places seen by Darwin and Fitzroy, in particular the raised platforms on Santa Maria. In 1910 the water was about 5 feet deeper than in 1835. Now we know that this phenomenon is due to plate tectonics (the Nasca plate being subducted under the South American plate). Dr. Wesson concluded by saying that Darwin’s scientific methods were still valid today.

A member of the audience asked about the controversy with Wallace who had sent Darwin his ideas on evolution before Darwin had published. Dr. Wesson spoke of the English class system and explained that Darwin was at the top of the social rung, whereas Wallace was a self made man. Darwin’s associates decided that his and Wallace’ papers should be presented simultaneously. This outcome would probably not occur today.