GEOBROWSER

Ghostly happenings at Death Valley

A mystery surrounding the Racetrack Playa in Death Valley National Park has now been solved. Its dried-out surface is littered with large isolated stones that can weigh more than 100 kg, but which have clearly moved very recently, under their own volition and with a sliding motion, creating shallow gouge-marks on the mud substrate (*Hobart King: Geology.com)*. They are found within a perfectly flat lake basin, a playa, about 4 km long by 2 km wide, which fills only infrequently after heavy rainstorms in the mountainous hinterland. It is thought that these storms could loosen rocks high on the steep slopes bordering the playa. If the rocks then reached the lake basin they could then begin to slide, but no-one had witnessed this phenomenon, so how could it happen? The absence of any other imprints shows that the stones have not been moved by animals or people, but it did seem that the prevailing southwesterly winds were somehow involved, since most of the gouge marks are parallel to that direction. The circumstances surrounding such movements have long been debated, however, since it would clearly take a significant input of wind energy to get a stone to slide, even on a very low-friction mud surface.

The mystery was finally resolved over the winter of 2013/14, when a lake up to 8 cm deep covered the playa and then froze. Researchers then observed many ice-embedded rocks moving slowly across the playa on several dates in December 2013 and January 2014, and the Scripps Institution of Oceanography even have a video clip of the phenomenon. By February 2014 the lake had dried up, and new trails left by the recently-moved rocks could be seen in the playa sediment surface. Further confirmation came from rocks that had been fitted with small GPS recorders, which showed around 100 m of travel during at least four episodes of movement. The researchers concluded that the stones were able to travel because the ice sheet in which they were embedded floated on a thin layer of water, and was thus easily susceptible to movement through wind force alone. This mechanism recalls the action of erratics which, embedded in moving glaciers, grind out striae on the underlying bedrock surface.

Did a volcano help decide European history?

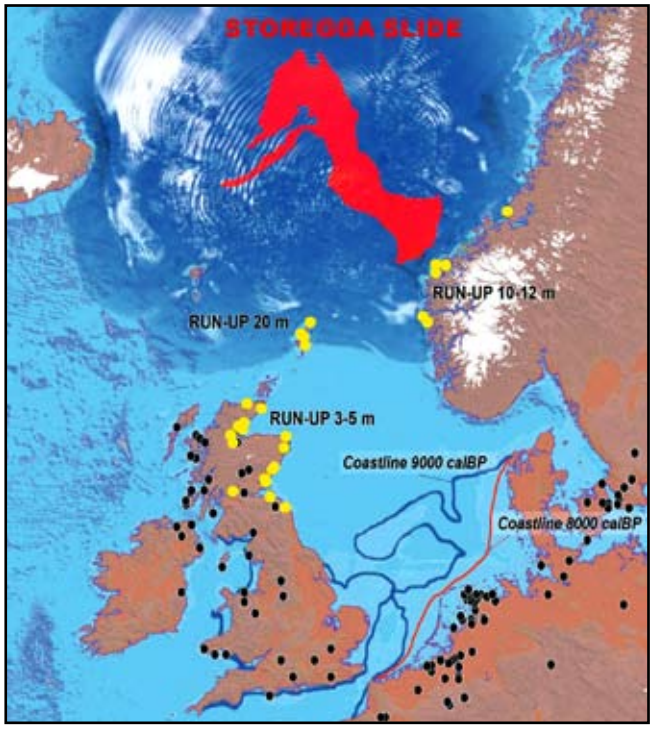
This year sees the bicentennial of two major events; although one is historical and the other geological, the two may have been closely linked. On the 18th of June, 1815, Napoleon's army was defeated at Waterloo - but only just, as the Duke of Wellington acknowledged: "*….the nearest run thing you ever saw*". In addition to valour and strategy, one factor that swayed the issue was the unprecedented rainfalls of that morning, and throughout the day before. This extraordinary weather is depicted by paintings such as that of Andrieux (1852), which show an apocalyptic sky, and it was remarked upon by many, including an English officer, Captain Mercer, who noted that: "*….Large isolated masses of thundercloud, of the deepest, almost inky black, their lower edges hard and strongly defined, lagged down, as if momentarily about to burst,….. involving our position…..(in) deep and gloomy obscurity" (www.napoleonsociety.com)*. The clayey substrate of the battlefield became saturated, forcing Napoleon to delay his attack and, crucially, closing the time-gap to only three and a half hours before the relieving Prussian army arrived *(https://reginajeffers.wordpress.com)*.

Such weather was clearly atypical, even for a northwest European summer during the later stages of the Little Ice-Age, but may be explained by an event that had happened far away in the East Indies. Nine weeks before Waterloo, between April 5th and 10th, the most violent eruption for some 2000 years occurred on the Indonesian island of Sumbawa, when the dormant Tambora volcano exploded. According to estimates (W & N Klingaman, *The Year without Summer, 2013*), many millions of tonnes of ash and 55 million tonnes of sulfur dioxide gas were ejected more than 30 km upwards. The sulfur dioxide then combined with water vapour to produce more than 100 million tons of sulfuric acid. All this material was vented into the stratosphere, where there are no clouds or rain to wash it away; hence the pollutants remained suspended in the air. The effects were global: estimates suggest it took only two weeks for the equatorial region to be encircled, and after some two months the aerosol cloud had reached the North and South Poles. By the winter of 1815–16 the entire globe was veiled in ash, wreaking havoc on weather patterns and causing those famous red sunsets that influenced Turner's great paintings'.

The Storegga tsunami: a prehistoric tragedy

The Asian tsunami of Boxing Day 2004 (*Mercian* 2005, p.99) proved just how vulnerable humanity is to the forces of nature. And with hindsight it was almost predictable, given the location of the stricken area along a major subduction zone. The Storegga tsunami, however, happened far away from any active seismic area, worryingly on our own doorstep, and was triggered by one of the largest submarine slides ever documented on Earth. Radiometric dates from a suite of 89 submarine cores within the slide region suggest that the main, retrogressive event took place at 8100±250 cal. years BP (*Marine @ Petroleum Geology, 22, 2005, 123-136)*, closely overlapping with the 8110±100 cal. years BP age for tsunami sands identified from various Mesolithic coastal settlements bordering the North Sea (*Documenta Praehistorica, XXXV, 2008, 1-24*).

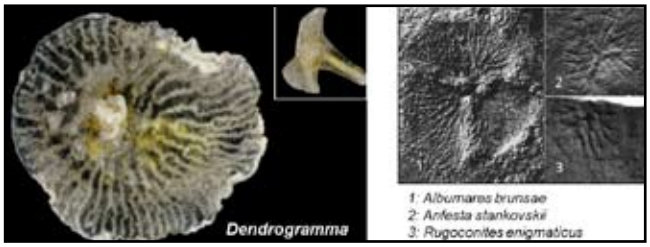
The human cost of this has recently been assessed by a study (*Geology 2014; doi:10.1130/G36278.1.*) which suggested that exposure to the disaster would have been greatest in late autumn, when the Mesolithic hunter tribes returned to over-winter at the coast. Unfortunately, it appears that the catastrophe occurred at just that time of year; a conclusion based on those tsunami deposits with entombed stem samples of the moss *Hylocomium splendens*. These plant fragments have retained their green colour and chlorophyll, showing a level of maturity typical of growth occurring from October through to December. So the Storegga tsunami must have affected a large proportion of peoples just returned to their coastal homes in western Norway and northeast Scotland. Even the survivors would have faced a very difficult winter of destroyed dwellings, boats, equipment, and supplies.



The European continental shelf, the Storegga slide, and sites with dated tsunami deposits shown by the yellow dots.

As a postscript, we note that a major flood figures prominently in the creation myths of the Celtic and Norse peoples that inhabited the North Sea and Atlantic coastlines. The Storrega tsunami occurred a few thousand years before the Celtic and Norse cultures developed, but given the capacity for humans to embellish stories handed down by oral tradition through the generations, and perhaps from culture to culture, could this mythology have had some basis in fact?

Ediacarans alive: a new coelacanth moment?

When formulating his theories on evolution, Charles Darwin relied heavily on the fossil record, but the famous coelacanth discovery shows just how incomplete this can often be. The coelacanth is perhaps the best known example of a 'Lazarus taxon': it represents an evolutionary line thought to have died out some 66 million years ago, only to reappear in 1938 when one was fished up off the east coast of South Africa. An even longer 'discovery gap' may have emerged last year, however, when Jean Just, a zoologist at the Natural History Museum of Denmark, found 18 odd-looking invertebrates while sorting through specimens dredged up from between 400 and 1000 m depth in the Tasman Sea. Just's study (in the September 2014 issue of *PLOS ONE, doi:10.1371)* describes 14 mushroom-shaped animals, up to about 1 cm in length, which are clearly multicellular and asymmetrical, with a gelatinous layer between the inner and the outer body. They have been classified under a new genus; *Dendrogramma*, and although they have no obvious affinities to modern phyla, microscopic investigations suggest similarities to jellyfish (Cnidaria) and comb jellies (Ctenophora): DNA analysis may follow if suitable material has been preserved, or if new specimens can be found.

Particularly intriguing to the researchers, however, are the similarities between the living *Dendrogramma* and the fossils *Albumares*, *Anfesta* and *Rugoconites*. The latter are known only from Ediacaran assemblages and are currently lumped into the extinct kingdom 'Vendozoa', which disappeared from the record at the end of the Precambrian, around 542 million years ago. This may simply be an example of morphological convergence, where apparently similar structures have evolved in organisms from different lines of descent. The evidence for a direct comparison is nonetheless compelling and, if confirmed by further studies, this would prove to be a major discovery, enabling the three Ediacaran forms to be reclassified as the half-a-billion-year-old ancestors to either the Ctenophora or Cnidaria, depending on where *Dendrogramma* is finally placed.