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Scotland during the Ice Age: geological outreach by Henry Moubray Cadell, Edinburgh, 1888.

The Scottish geologist and coal mining entrepreneur Henry Moubray Cadell (1860–1934) enjoyed a remarkable career (Mendum 2010). With qualifications from the University of Edinburgh and the Clausthal Royal Mining Academy in Germany, he commenced work in Scotland with the Geological Survey in 1883. He was one of the team set to unravel the structural complexities of the NW Highlands and is well-known for his series of experiments using a mechanical ‘squeeze-box’ to produce fold and thrust deformation in layered sediments. On the death of his father on 8 January 1888, Cadell resigned from the Geological Survey to take-over management of the extensive family business, based in West Lothian, with interests in coal mining, industry and agriculture. Thereafter, he also travelled widely to many parts of the World and took a leading role in public and civic affairs (Mendum 2010). For the Edinburgh Geological Society, he served as both secretary (1888–1897) and president (1898–1899 and 1927–1928).

Throughout his life Cadell maintained an admirable output of scientific papers (many based on geological results arising from his coal mines in West Lothian and published in the *Transactions of the Edinburgh Geological Society*), geographical accounts of his world-wide travels, popular books on Scottish geological themes, and technical reviews. In a fulsome obituary, Macgregor (1935) listed 96 publications of various kinds between 1880 and 1933. Macgregor also commented on Cadell’s artistic ability, and that talent is well illustrated by the water-colour paintings and numerous sketch books now held in an extensive Cadell archive by the National Library of Scotland (NLS). Macgregor noted particularly that “He loved specially to try his hand at reproducing scenes from the past: West Lothian in the Carboniferous Period, the Forth Valley in late-Glacial times, etc.” Examples of both those subjects are present in the NLS archive (Acc.5381/72/1–18).

The illustration of West Lothian in the Carboniferous Period is a relatively small water colour painting (Figure 1) with the title “Imaginary scene in Carboniferous Period, West Lothian” written on the back. Volcanoes are shown erupting amidst tropical vegetation, though the Plinian-style eruptions depicted might not have been characteristic of what was largely intra-plate volcanism. The painting is undated but may have been produced by Cadell whilst writing his book on West Lothian geology, published in 1925, where a similar image but with slightly different layout and detail appears as a black and white photograph facing page 184. He certainly had a long-standing interest in the subject and had begun publishing a series of related papers whilst still at the University of Edinburgh between 1878 and 1881. Also from that period, the NLS archive holds the text of a lecture entitled ‘The Lothians during the Carboniferous Period’ (Acc.5381/44) that he delivered on 7 March 1879 to the ‘Philopolemic Society’ – probably a students’ debating club – in which volcanoes featured prominently.

Cadell’s imaginings of glacial times in the Forth Valley were certainly created for public display. Three large black and white drawings illustrate different time intervals in the Forth Valley: ‘Beginning of the Human Period’, ‘Near the end of the Great Ice Age’, and ‘Preglacial Landscape’ (Figure 2). On the back of ‘Preglacial Landscape’ is written “The Forth Valley from the Abbey Craig” (the Wallace Monument had been erected on Abbey Craig in 1869) so the scenes look SW

towards Stirling. They were clearly intended to be displayed together, and another note written on the back of 'Preglacial Landscape' stipulates the order in which they were to be presented, one above the other as in Figure 2. Their likely purpose is suggested by a rather tattered flyer preserved elsewhere in the NLS archive advertising a lecture to be given by Cadell at the inaugural meeting of the 'St James' U. P. Church Rambling Club' (Figure 3): "Scotland during the Ice Age", to be "illustrated by diagrams" (Acc.5381/71). Two of the three drawings subsequently reappeared as illustrations in Cadell's 1925 book, facing page 288. An imagined view of the preglacial Linlithgow valley also features in the book, facing page 266, but the original drawing has not been located.

The meeting of the Rambling Club took place on Thursday 31st May and although the year is not specified it can be established by Cadell's credentials listed on the flyer, notably F.R.S.E. and H.M. Geological Survey. He was elected a Fellow of the Royal Society of Edinburgh on 7 March 1887 and resigned from the Geological Survey in 1888; hence the meeting could not have been held before 1887 and probably not much later than 1888. As 31st May was a Thursday in 1888 but fell on a Tuesday in 1887 there is little doubt that Cadell lectured in 1888. The venue, St James Church, formed part of the site in Edinburgh now occupied by the St James shopping centre. Perhaps Cadell would have delivered the same lecture to other audiences elsewhere at around the same time and the text of an earlier lecture, with the title 'The Great Ice Age' and read on 21 February 1884 before the Free St George's Literary Association – probably in Shandwick Place, Edinburgh – is also held by NLS (Acc.5381/44). It will not have been a coincidence that his title matched that of James Geikie's influential book published in two editions during the 1870s.

That 1884 lecture text makes no reference to illustrations and draws most of its examples from the Edinburgh district. It is a comprehensive account placing much emphasis on the origin of boulder clay – till – as the subglacial deposit from an extensive ice sheet and so rejecting the previously popular theory of its deposition from melting icebergs. Cadell ranged widely over the history of glacial theory, gave credit to the work of Louis Agassiz and James Croll, discussed the opposition that their ideas experienced, touched on glacial erosion and the origin of fjords, and described the evidence for substantial changes in relative sea level. Typically for the time, his style is a bit loquacious, and he ends with a religious flourish: "Is not all this a marvellous tale, altogether too wonderful to understand! What cold skeptic will dare assert that our history is a mere series of curious coincidences? Where is the blighted materialist who is bold enough to declare that all nature is ruled by a rigid code of Law without a Divine Lawgiver behind it?"

In the illustrations produced for the 1888 lecture (Figure 2) Cadell imagined the preglacial landscape as sparsely forested, with dramatic cliffs cut into the dolerite of the late-Carboniferous Midland Valley Sill Complex and towering over a fast-flowing river. The highest crags then form reference points through the two subsequent time intervals – Stirling Castle now sits on the most prominent, central crag. The illustration of the scene 'near the end of the Great Ice Age' shows the area inundated by the sea with a notable feature being the large number of ice floes all loaded with a temporary cargo of erratic boulders. Given his 1884 dismissal of the 'iceberg theory' this might seem a little odd.

In the text for his 1884 lecture, Cadell notes that transport of erratics by icebergs had been a popular hypothesis early in the 19th century before their delivery by glaciers and icesheets became the consensus view, with till – boulder clay – recognised as a predominantly subglacial deposit. All this had been discussed at length in James Geikie's authoritative book 'The Great Ice Age' which he wrote whilst working with the Geological Survey before leaving that organisation in 1882 to become Professor of Geology at the University of Edinburgh. Cadell was now applying Geikie's interpretations of glacial phenomena to local circumstances.

Of course, Geikie allowed some limited transportation role for floating ice, rock debris in icebergs was after all commonly observed. And more specifically, Cadell would have been well-aware of the isolated boulders found in the marine and/or estuarine clays that underlay much of the low ground shown in his 'Beginning of the Human Period' scene – clear evidence for ice-rafting. But how did what appear to be ice floes created by the seasonal break-up of sea ice become loaded with erratics? Geikie had proposed and illustrated (Figure 4) a winter fringe of solid ice at the base of cliffs on which frost-shattered debris accumulated, that then broke-up into multiple floes during the summer, and this may have been the model Cadell had in mind. We can be confident that the whole story was recounted in detail for the St James' Ramblers.

References

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Figures

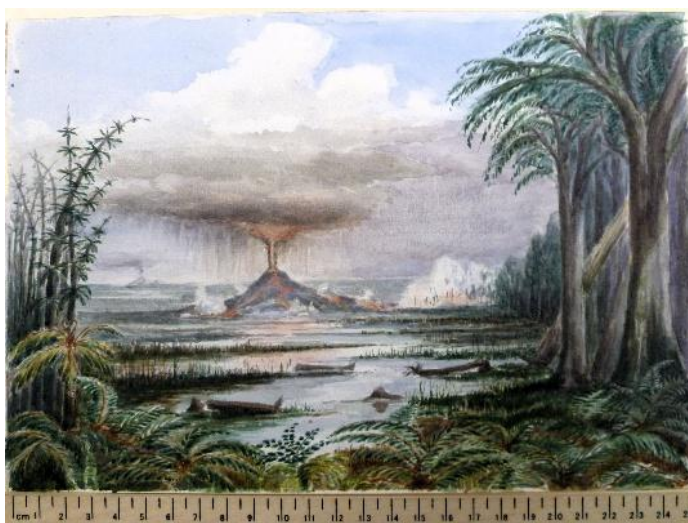


Figure 1. Imaginary scene in Carboniferous Period, West Lothian, a watercolour painting by H.M. Cadell. From an original held by the National Library of Scotland.



Figure 2. The series of three drawings produced by Cadell to illustrate his 1888 lecture on “Scotland during the Ice Age”. For this compilation the left and right margins of the drawings have been cropped: the full width of each one is 78 cm. For the lowermost drawing, the title ‘Preglacial Landscape’ is written on the back. From originals held by the National Library of Scotland.



Figure 3. The advertising flyer for Cadell's lecture on "The Ice Age in Scotland". From an original held by the National Library of Scotland.

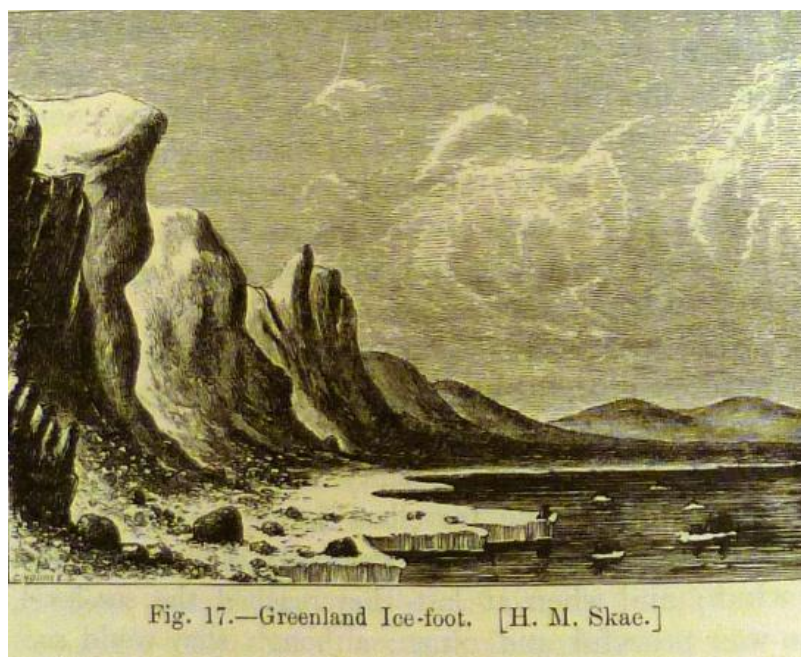


Figure 4. The illustration from Geikie (1877, p. 54) showing rock debris accumulating on ice at the foot of a sea-cliff in Greenland. The artist, H.M. Skae, was a colleague of Cadell's during the latter's time with the Geological Survey but died prematurely in 1889 aged only 42.

