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The forgotten pioneers of graptolite palaeontology in the Southern Uplands of Scotland

By Phil Stone

In the last issue of *The Edinburgh Geologist* we celebrated Scotland's 'Golden Spike', the internationally agreed section at Dob's Linn, Moffatdale , that defines the base of the Silurian System. There, in the mudstone of the Moffat Shale Group, graptolites provide the crucial biostratigraphic control and their detailed appraisal by Charles Lapworth (1842–1920) has underpinned all subsequent interpretations of Southern Uplands geology. Lapworth's seminal paper, published in 1878, ranged well beyond Dob's Linn and covered all the important Moffat Shale exposures of the central Southern Uplands: Hartfell Spa, Craigmichan Scars, Glenkiln Burn and many others. So comprehensive was Lapworth's work that his reputation now dominates any historical assessment of biostratigraphic developments in the Southern Uplands. That is undoubtedly well-justified, but of course he did not work in a scientific vacuum, nor was he the only palaeontologist active in the field in the mid-19th century. This article seeks to identify some of Lapworth's forgotten colleagues and predecessors and to acknowledge their contributions.

Graptolites had been noted early enough for a genus *Graptolithus* to be established as early as 1735 by the great taxonomic classifier Carolus Linnaeus (1707–1778). Not that he knew what they were; the 'writing on the rocks' might be animal, vegetable or mineral. But by the early 19th century the true nature of graptolites had been realised, with about eight taxa defined by 1840 (Rushton, 2001).

The first discovery of graptolites in Scotland was made in about 1838 by John Carrick Moore (1805–1898). He found the fossils on the west shore of Loch Ryan, Galloway, at a locality known as Slouchnagarry [NX 034 707] about 2 km north of his home at Corsewall. Moore passed the specimens to Charles Lyell (1795–1875) who announced the discovery at a meeting of the Geological Society of London on 23 January 1839. The brief note of the presentation would appear to claim that it was Lyell himself who first noticed the fossils (Figure 1), but Moore (1840) makes clear that "Mr. Moore found in a slaty rock alternating with compact beds, an abundance of fossils, determined by Mr. Lyell to be graptolites." Confirmation comes from Moore's Geological Society obituary (written by John Judd): "… he was in communication with Charles Lyell, who identified the fossils found by him as graptolites." In terms of modern stratigraphy, those graptolites were found within the Kirkcolm Formation, one of the Upper Ordovician successions overlying the Moffat Shale. Moore (1849) followed-up his initial discovery with a remarkable traverse of the Rhins of Galloway, describing the graptolitic mudstone at Morroch Bay, 5 km SE of Portpatrick, now

recognised as part of the Moffat Shale Group, and identifying several more graptolitic horizons within the Kirkcolm Formation.

At around the same time, other 'amateur' collectors were also busy elsewhere. Harkness (1851, p. 54) noted that "Some time ago Lord Selkirk presented the Geological Society with a suite of fossils which had been collected by Mr. Fleming, of the Kirkcudbright Academy, on the east side of the bay of Kirkcudbright, and these fossils were named by the Geological Survey". Fleming's fossils – abundant graptolites and a sparse associated 'shelly' fauna including brachiopods and trilobites – were recovered from what is now known as the Raeberry Castle Formation (Riccarton Group); Wenlock in age, it is one of the youngest Silurian divisions in the Southern Uplands.

Meanwhile, graptolite studies in general had been driven forward by two palaeontological giants: the American, James Hall (1811–1898) who worked mostly in New York State, and the Frenchman Joachim Barrande (1799–1883) who was based in Prague from 1831 and thence worked extensively in Bohemia. Barrande became a hugely influential figure but, unfortunately, he developed the idea that graptolites were facies-dependent organisms that migrated into and out of any given area as the conditions changed. Moreover, as recolonisation could have occurred from a different graptolite 'refuge' (Barrande called them 'colonies'), the apparent succession of graptolites had no biostratigraphical significance. Hence, many contemporary studies of graptolites simply focussed on defining species and paid little attention to their mutual relationships; for more on this see Rushton (2001). They were simply regarded as indicative of a general Silurian age, at the time *sensu* Murchison but now spanning the Silurian and the Ordovician.

Back in Scotland, graptolite discoveries continued. In 1850, James Nicol (1810–1879) described them from Grieston Quarry near Innerleithen (his birthplace). The Grieston graptolitic beds are anomalously young for their structural position in the Southern Uplands and are now thought to lie within a tectonic outlier of mid-Llandovery (Silurian) strata surrounded by older Llandovery units. More extensive discoveries were made by Robert Harkness (1816–1878) (Figure 2) who ranged widely across the central Southern Uplands and published an extensive account of key localities encountered when tracing the outcrop of the graptolitic mudstone along strike from NE to SW (Harkness 1851). He identified three graptolitic 'bands', referring to the harder carbonaceous mudstones as 'anthracite' (and commenting on the levels for coal exploration seen in some places) and particularly noted the excellent exposures at, *inter alia*, Dob's Linn, Hartfell, Craigmichan Scars and Glenkiln Burn. Twelve species of graptolite were described in detail (Figure 3), whilst a footnote (*op. cit*. p. 58) records: "At the meeting of the British Association at Edinburgh in July 1850, a list was read drawn up by Prof. M'Coy, of fourteen species of Graptolites from the Silurian rocks of the south of Scotland." Only two species were thought to be in

common, so by 1850, it would seem that at least 24 graptolite species were known from the Southern Uplands.

Over the next twenty years information on Southern Uplands graptolites continued to accumulate, with about 25 relevant papers published between 1850 and 1870. Important contributors were Henry Alleyne Nicholson (1844–1899) and William Carruthers (1830–1922), with the growing database influencing successive editions of Sir Roderick Murchison's *Siluria*. Hugh Miller (1802–1856) also took notice, and a chapter 'On the ancient grauwacke rocks of Scotland' was added to the later editions of *The Old Red Sandstone*. Harkness published several more papers in which he developed the idea that all the Moffat Shale outcrops were parts of a single original succession that had been split-up and duplicated by faulting parallel to the NE-SW regional strike.

Lapworth had arrived in Galashiels in 1864 and began to explore the local geology, most probably in the company of his friend (and future co-author) James Wilson. His first paper, 'On the Lower Silurian rocks of Galashiels', was published in 1870 in *Geological Magazine*, but by then he had expanded his activities towards Moffat, into the Moffat Shale outcrops identified by Harkness and most importantly into the exposures at Dob's Linn. Other palaeontologists were also active in the area. John Hopkinson (1844–1919) published in 1872, in *Geological Magazine*, the details of some new graptolite discoveries "collected in the course of a few days' walking tour in these districts, during part of which I had the advantage of the company of Mr. Chas. Lapworth, of Galashiels …" from whom he anticipated imminent new publications. Significantly, Hopkinson affirmed that there was "but one band of graptolitic shale … there being in this band several distinct zones, each marked by a different assemblage of fossils, but with many species in common" (Hopkinson 1872, p. 501). Later in the same year Lapworth responded with his own *Geological Magazine* paper. He acknowledged Hopkinson and the influence of Harkness but noted that the latter's proposal that the various Moffat Shale outcrops "were originally portions of the same deposit" repeated by faulting had not met with general acceptance (Lapworth 1872, p. 534). Instead, it was more widely believed that there were several distinct Moffat Shale bands, at different levels in the stratigraphy, a view notably adopted by the Geological Survey for whose study of the region the fossil collector Arthur Macconochie had visited hundreds of localities and amassed thousands of graptolite specimens.

In his 1872 paper Lapworth supported the Harkness and Hopkinson view, but noting the prevalence of the alternative opinion (not to mention the continuing influence of Barrande) he admitted that "it will require no slight weight of contrary evidence to displace it" (*op. cit*., p. 534). He went on to outline his interpretation of the Moffat Shale as a single succession that could be divided on lithological and palaeontological grounds into three divisions, further subdivided into zones on the basis of their graptolite faunas. Of the graptolites: "there are probably nearly a hundred different

species in all (of which at least one third are as yet undescribed).” Rushton (2001) saw this 1872 paper as Lapworth’s assertion of his priority for establishing – or at least independently recognising – the Moffat Shale’s internal biostratigraphy in the face of perceived competition.

It took Lapworth several more years to complete his work on the Moffat Shale. During that time, he would have been encouraged by news from Sweden, where Johan Gustaf Linnarsson (1841–1881) had established the vertical distribution of graptolites from relatively undisturbed strata in the south of that country. In 1876 Linnarsson published an account of his findings in *Geological Magazine,* and in that same year Nicholson published a comparison of the Scottish and Swedish faunas. Finally, in 1878, Lapworth was ready, and his monumental paper *The Moffat Series* was published in *Quarterly Journal of the Geological Society of London*. His work was so detailed, thorough and comprehensive that it presented an overwhelming case for the unity of the Moffat Shale and the biostratigraphic framework provided by graptolites. The Geological Survey’s interpretation was recognised as inadequate, which soon prompted a re-examination of the Southern Uplands led by Ben Peach and John Horne. Only Barrande offered serious resistance, the fifth and final part of his *Défence des Colonies* appearing in 1881; he was defiantly composing a sixth when he died in 1883. The conclusion of the story, Lapworth’s triumph, is now well known.

Key references

Harkness, R. 1851. On the Silurian rocks of Dumfriesshire and Kirkcudbrightshire. *Quarterly Journal of the Geological Society, London*, **7**, 46–65.

Hopkinson, J. 1872. On some new species of graptolites from the south of Scotland. *Geological Magazine*, **9**, 501–509.

Lapworth, C. 1872. Note on the results of some recent researches among the graptolitic black shales of the south of Scotland. *Geological Magazine*, **9**, 533–535.

Moore, J.C. 1840. On the rocks which form the west shore of the bay of Loch Ryan in Wigtownshire., N. B., *Proceedings of the Geological Society, London*, **3**, 277–278.

Moore, J. C. 1849. On some fossiliferous beds in the Silurian of Wigtownshire and Ayrshire. *Quarterly Journal of the Geological Society, London*, **5**, 7–17.

Rushton, A.W.A. 2001. The use of graptolites in the stratigraphy of the Southern Uplands: Peach’s legacy. *Transactions of the Royal Society of Edinburgh: Earth Sciences*, **91**, 341–347.

In their 1899 Geological Survey memoir, *The Silurian Rocks of Britain. Vol. 1: Scotland*, Ben Peach & John Horne provided a comprehensive appendix listing all the contemporary literature.

Figures

A notice on "the Occurrence of Graptolites in the Slate of Galloway in Scotland," by C. Lyell, Esq., V.P.G.S., was first read.

On examining some specimens of slaty sandstone and shale, collected by Mr. John Carrick Moore, on the shore of Loch Ryan in Galloway, Mr. Lyell discovered distinct remains of Graptolites, resembling those found in the Silurian strata of England and Sweden. As Mr. Lyell is not aware of these zoophytes having been before observed in Scotland, and as organic remains are exceedingly rare in the great range of slaty sandstone and shale which extends from St. Abb's Head to Galloway, he considers the discovery of a fossil, affording a test of the relative age of those beds, not unimportant. The strata containing the Graptolites are nearly vertical, and their strike is west-south-west and east-north-east.

Figure 1. Charles Lyell's 1839 announcement of the discovery of graptolites in the Southern Uplands of Scotland, as recorded in *Proceedings of the Geological Society, London*, volume 3, page 28.

Figure 2. Robert Harkness (1816–1878), a pioneer of graptolite palaeontology in the Southern Uplands, in an 1854 portrait by James Butler Brenan (1825–1889). Harkness lived in Dumfries for many years and from 1853 to 1876 was professor of geology at Queen's College, Cork, Ireland. Image courtesy of the Department of Earth Sciences and Sedgwick Museum, ©University of Cambridge: Accession No 119.

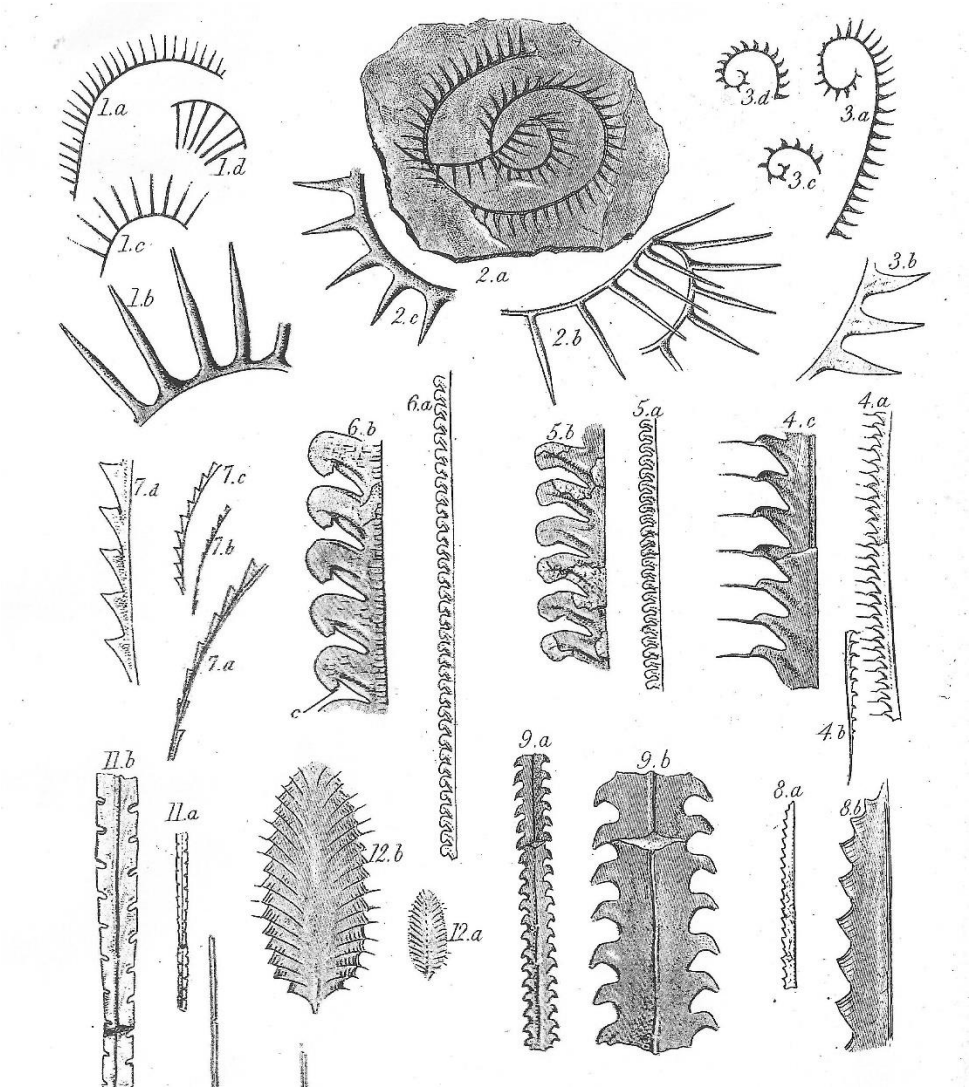

Figure 3. Some of the graptolites illustrated in fine detail by Harkness in his 1851 paper published in the *Quarterly Journal of the Geological Society, London*, volume 7, pages 46–65. The accuracy of the representations can be seen by comparison with the specimens shown in Figures 4 and 5.

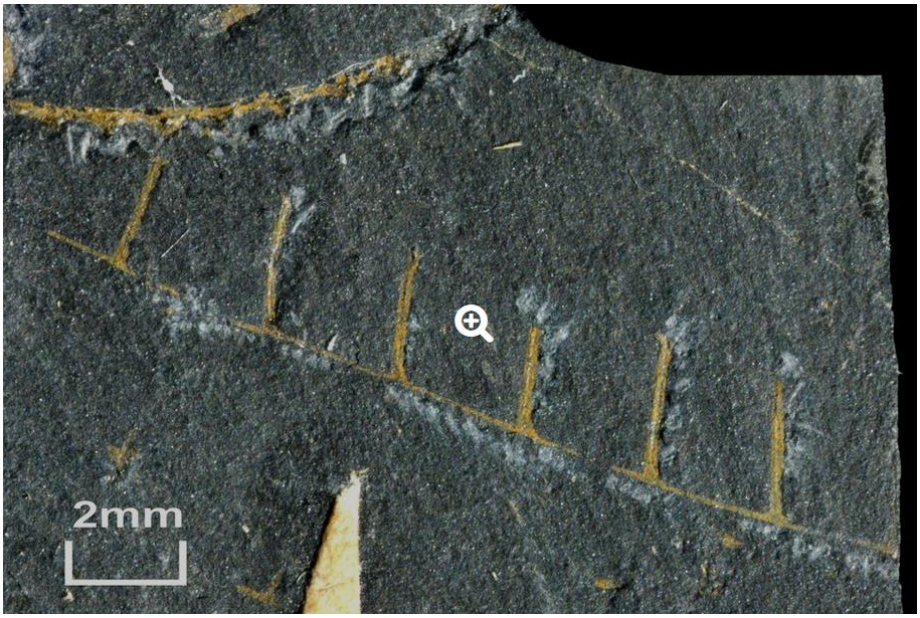

Figure 4. A specimen of *Rastrites abbreviatus*, one of the graptolite species illustrated by Harkness in his 1851 paper; see illustrations 1 and 2 in Figure 3. *R. abbreviatus* is a Llandovery (Silurian) graptolite and this example comes from the Moffat Shale Group at Clanyard Bay, Rhins of Galloway. BGS image P521153 ©UKRI.

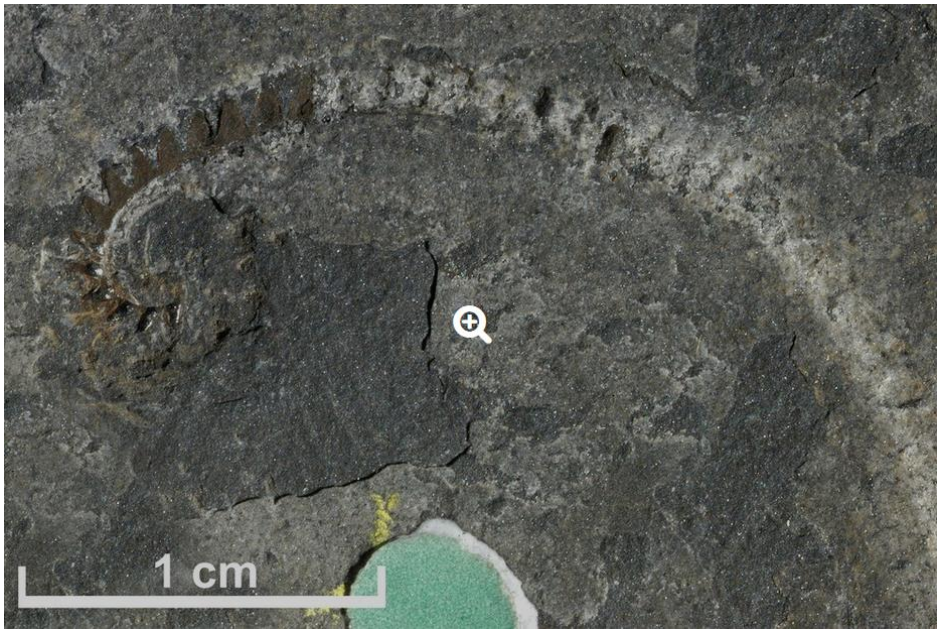

Figure 5. A specimen of *Monograptus triangulatus*, one of the graptolite species illustrated by Harkness in his 1851 paper; see illustration 3 in Figure 3. *M. triangulatus* is a Llandovery (Silurian) graptolite and this example comes from the Moffat Shale Group near Ardwell Point, Rhins of Galloway. BGS image P521160 ©UKRI.