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“Something like a Spider’s Web” - Craigellachie Bridge 200 and its significance

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[From the author’s lecture at the bicentenary of the bridge in Craigellachie Village Hall on 1 Nov.2014]

Craigellachie Bridge [Fig. 1] is more than an outstanding environmental attraction of the Spey Valley, it is an internationally recognised iron masterpiece of Eskdale-born Thomas Telford (1757-1834) FRSE&L, one of the greatest civil engineers and his exceptionally competent ‘Merlin’ ironfounder partner, William Hazledine (1763-1840). The first arch of their innovative, light-weight, prefabricated, landmark creation was erected at Bonar in 1812 to carry the Great North Road over the Kyle of Sutherland, providing an alternative to crossing Dornoch Firth at Meikle Ferry 9½ miles downstream. Shortly after Bonar bridge opened, a Sutherlander, whose father had been drowned at Meikle Ferry, on approaching it from a distance, likened the bridge to *‘something like a spider’s web in the air ... it will never do! But presently I came across it, and oh, it is the finest thing ever made by God or man!’* It served until January 1892 when its river pier was overturned in a flood.

In the summer of 1812, as Bonar Bridge was nearing completion, the Craigellachie Bridge project was initiated by Col. Sir William Grant and John McInnes of Dandaleith, a farmer whom the author’s recent research reveals acted as honorary *Inspector* for the work. His reports to Telford as Engineer to the Highland Roads and Bridges Commissioners [HRBC], and their Agent James Hope, shed fascinating new light on the bridge’s erection.

Soon afterwards, in September 1812, Telford reported,

‘At Craig-Ellachie I met Provost Brown of Elgin, Mr Young of Bamff, Mr McInnes and others interested in the application to the Commissioners for aid in constructing a bridge’, which he was ‘convinced’ would be beneficial locally and in connecting Elgin with the south side of the Spey and also, via Rhynie, with new bridges over the Don at Alford and the Dee at Potarch.

Telford continued, *‘Having measured the width of the river and learned the height to which the floods rise, and having considered the nature of the foundations, the depth of water, and other circumstances, I became satisfied that any stone bridge with piers in the river would cause an expense and continual risk, but an iron arch of the same span as that at Bonar (150 ft) I am convinced might be accomplished for about £8000. I have prepared a Plan, Elevation and detailed Estimate, about £1000 of which must be incurred for driving a gallery into the Rock ... formerly the alarm-post or fire signal station of the Grants ... this being the only practicable mode of approach from the North.’*

(signed) ThomasTelford.

A subscription list for the bridge as at October 1812, sent by Mr Fraser of Castle Grant to McInnes, some of which is difficult to transcribe, reads: Col Sir W Grant £1,200; Arndilly £300; Balindalloch £200; Aberlour £200; Mr Young for Kininvie £100; Mr Grant of Elchies £300; Lord xxx’s trustees £100; Duke of Gordon £200; Town of Forres £50; Sir H and Rev Mr Grant £20; P. Keith MP £21; Rev Dr Nicol 5gns; Capt Grant of Tullochgorm 2gns; A Gordon, Cairnfield 5gns; Maj Grant, Achermich 5gns; Mr L Dick, Relugas 5gns; B Lawson, Ballimore 5gns; Mr Fraser, Castle Grant 10gns; Capt Cumming,

Docharn 5gns; Mortlach & Cabrach tenants £240; B Abercromby MP 5gns; Morayshire Farmers Club £33.12s; Mr Chalmers, Aberdeen 2gns; Rothes & Provost Brown [Elgin] £175; Mr Niven, Lumsden 5gns; Mr Urquhart Meldrum 3gns; Mr Grant, Drummner 5 gns; Dr Leith, Whitehaugh 5gns; Mr Farquharson, Bryda 5gns; Mr Farquharson, Naughton 5gns; Mr Rannie, Cullen 5gns; Mr Staples, Cullen 3gns; Jo. Ingram, Keith 2gns; Mr Grant, Cullen? £5; Mr A McWilliam, Buss £2; R Bremner £4; James Gordon, Rivals £1; Jno Lobar, Cumiston £2; Rev G Innes, Cullen 5gns; Subscriptions at Aberdeen. Mr McInnes £40; Ja Grant, Heathfield 5gns; Rev Macpherson, Knockando 10gns; Rev Grant Inveravan 10gns; Sir G Abercromby Bt 10gns; Robert Warden £21; T Wilson Cullen House; A Wilson, Cullen 10gns; Jas Shearer £50; Mrs Grant, Elchies £20; Rt Hon Sir Wm Grant £30; A Grant, Tullochgriban 5gns. Total £3,497.6s.

By October 1813 subscriptions had reached £4,000, the requisite 50% of Telford's estimate to attract a 50% government grant, and a contract for executing the work, with an iron arch almost identical to that at Bonar, was agreed with one of Telford's most reliable contractors who had just erected Bonar Bridge, Simpson and Wilson, and work at Craigellachie began. By 22 December the breast wall at the north side, and the south approach embankment were in progress [McInnes].

Despite delays from intense cold and snow, and occasional high river levels, on 28 May McInnes reported about 70 men at work and that about 300 yds of the breast wall and the foundations to the arch springings on timber-piled platforms had been completed. The temporary timber centering, to support the arch ironwork during fixing, was being framed. Its supporting piles across the river were in place and tied with beams forming a platform, secured against ordinary flood risk, which was in use as a service bridge for 'wheeling rock rubbish' from the North side [Fig. 2]. The piles were man-power driven until 3 strokes of the engine ram of 3 cwt {152 kg} raised 5 ft did not drive the pile 1 in.

In July 1814 Hazledine's £2,891, 180 ton, bespoke iron arch, its elements each weighing up to 3 tons and of maximum length 23 ft was on its long journey. They were transported from their Ruabon foundry at Plas Kynaston, by barge across 'Telford's 'supreme structural achievement of the canal age' [Paxton 2004], Pont Cysyllte Aqueduct, via the Ellesmere and Chester Canals to Ellesmere Port, from where they were shipped to Spey Mouth and then carried by waggon to Craigellachie. Unlike the Bonar arch which was pre-erected at the foundry for public inspection on 5 June 1812, the author has not found any evidence that the Craigellachie arch was so pre-erected. Remarkably this arch was erected on its awaiting centering in just a few weeks during August and September under the direction of William Stuttle, Hazledine's expert foreman, who had been in charge of casting and erecting the Bonar arch. By October, the 'most Herculean labour' of rock blasting the north approach road was still in progress and the bridge was not officially opened until the 1 November 1814.

The November issue of the *Scots Magazine* graphically reported the bridge opening which '*... to the astonishment of all who have beheld it ... the passenger seems like entering a frightful cavern excavated in the rock 100 ft perpendicularly ... with no apparent outlet, but on rounding the turret he finds himself extricated from this labyrinth by a smooth and spacious passage*'. John Simpson the contractor was praised for completing the whole in masterly style, praise which was well deserved as he finished out of pocket on the contract because of the extensive rock excavation! [Figs. 1 & 2].

After 150 years of valuable service, surviving the great flood of 1829 (apart from its south approach and three 15 ft arches), deck strengthening in 1902, and carrying 'extremely heavy' military vehicles from 1939-45, the bridge was reconstructed above its original ribs and cross-bracing in 1963-64 with

care taken to retain its original character. This involved replacement steel spandrels, deck beams and railings, but the original deck plates were retained to support a reinforced concrete deck [Fig. 3]. The bridge was bypassed in 1972 by its present steel beam and concrete successor.

In 2007 at the author's initiative on behalf of the Panel for Historical Engineering Works of the Institution of Civil Engineers with its mission of encouraging excellence in conservation of the finest historical engineering works, and with wonderful support from the Moray Council, local people, and the American Society of Civil Engineers [ASCE], this A-listed bridge was dubbed an International Historic Civil Engineering Landmark, recognised at the bridge by the knowledge-promotion plaque presented by the American Society and erected by the Moray Council on a fine masonry plinth.

Craigellachie Bridge is technically outstanding as the world's earliest surviving example of an innovative, light-weight, prefabricated cast iron bridge type which made a significant contribution to Britain's roads before the railway age. With spans longer than then practicable in stone, and exhibiting an unparalleled combination of strength, economy and intuitive design, at least ten arches were erected nationally as far south as Tewkesbury. By 1830 the genre had been adopted in nearly half of all the world's cast iron bridges with spans over 32 m. Cast iron, the only form of iron then practicable for use in bridge improvement was far from ideal for beams, being weak in tension but it was strong when used in arch-ribs and struts. Its effective use in the Bonar/Craigellachie genre on an intuitive and experimental basis before modern theoretical practice developed was remarkable. It achieved a unique 'spider's web' lightness. by distributing forces throughout the whole framework using high quality ductile castings of nearly half the tensile strength of modern mild steel. in addition to traffic loads it has been able to accommodate a temperature range movement of about 1 in.

For about half a century after Telford's death in 1834, until the 1890s when the use of cast iron in arches declined in favour of bridges in the new material, mild steel, the elegant lozenge spandrels of the Bonar/Craigellachie genre, developed to its zenith at Tewkesbury in 1826 with vertically orientated spandrel framing, enhanced scores if not a hundred bridge elevations throughout the United Kingdom, many on railways. A fine local example is Carron Bridge 1863, about five miles upstream of Craigellachie. It was erected using large castings then available with improved iron manufacture, by Alexander Gibb, Engineer for the Strath-Spey Railway, formerly another outstanding Telford contractor, who had built Dean Bridge, Edinburgh, and Glasgow Bridge.

Since being bypassed the bridge has received little maintenance. In July 2014 the Concrete & Corrosion Consultancy Practice Ltd [Concorr] at the initiative of the Moray Council inspected the bridge and found it to be in generally good condition, but in need of refurbishment costing of the order of £400,000 to keep in good order [Fig. 4]. With its use now limited to recreational, educational and environment enjoyment as an international historic monument, this is too large a sum to expect the Council to find from its bridge maintenance budget. Help with funding to obviate further deterioration of the bridge should be sought not only locally, but from the National Lottery, government departments and agencies and heritage and tourism bodies. To this end the establishment of the 'Friends of Craigellachie Bridge' is most welcome and hopefully will provide the essential local support to ensure the bridge's preservation for the next 200 years.

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Figures and captions

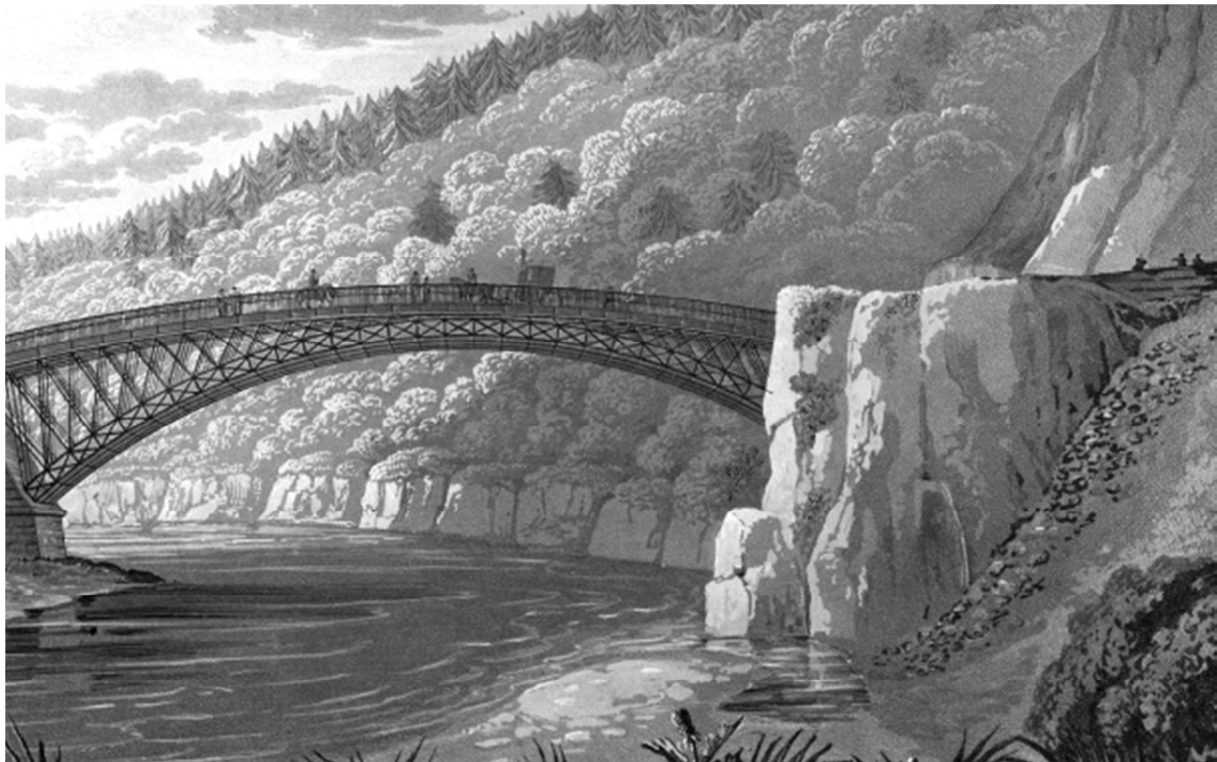
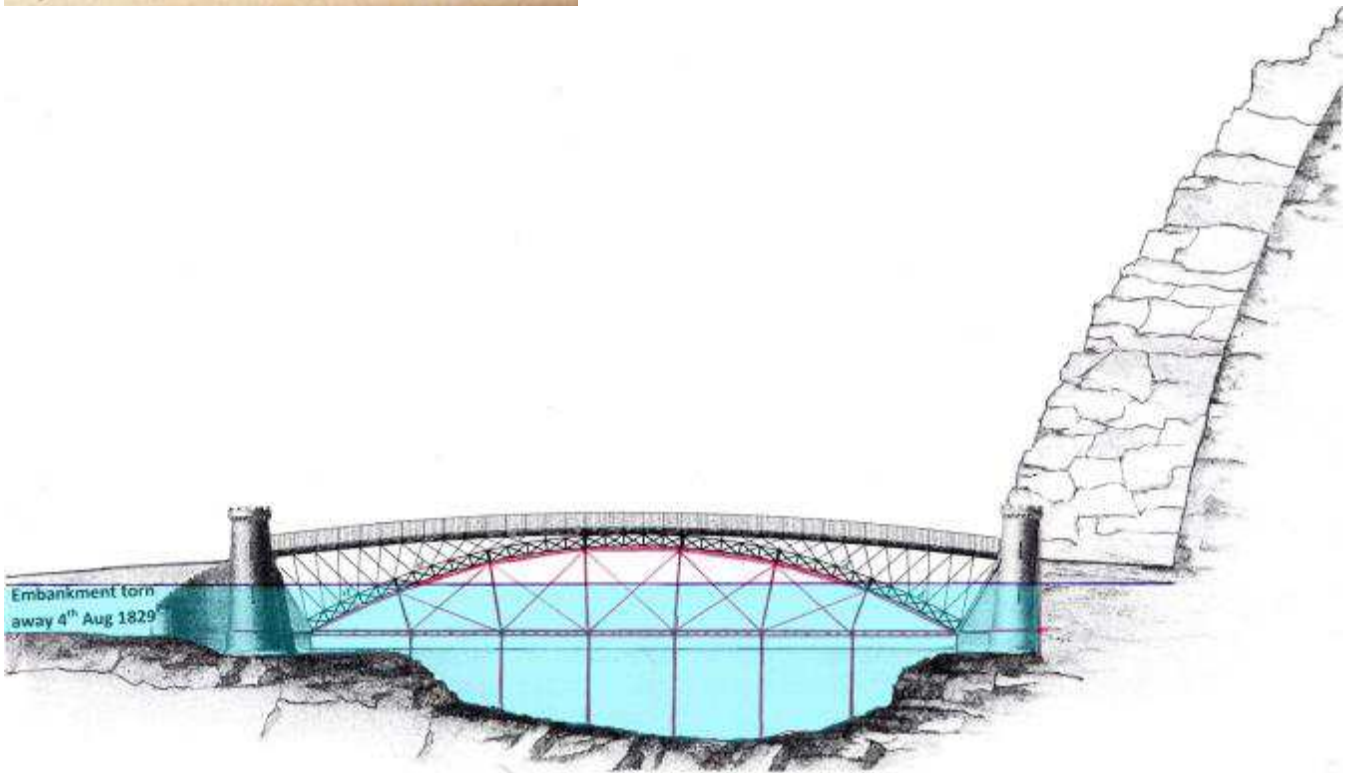
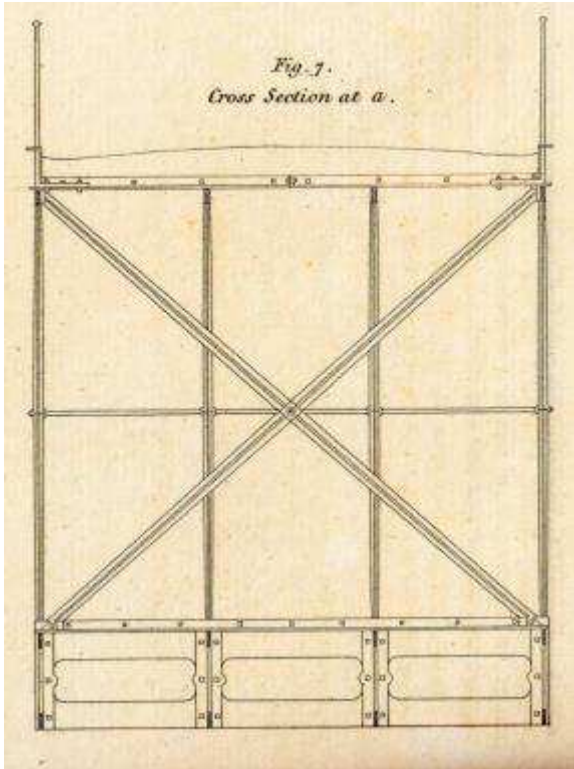


Fig. 1 Craigellachie Bridge soon after completion. Drawn and published by J. Grant, Elgin. ©Paxton



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Fig. 2 Notional arrangement of larch centering, Aug 1814. Platform across river used for 'wheeling rock rubbish'. Note huge excavation at Rock. 4 Aug. 1829 flood extent in blue. Inset, Telford X-section

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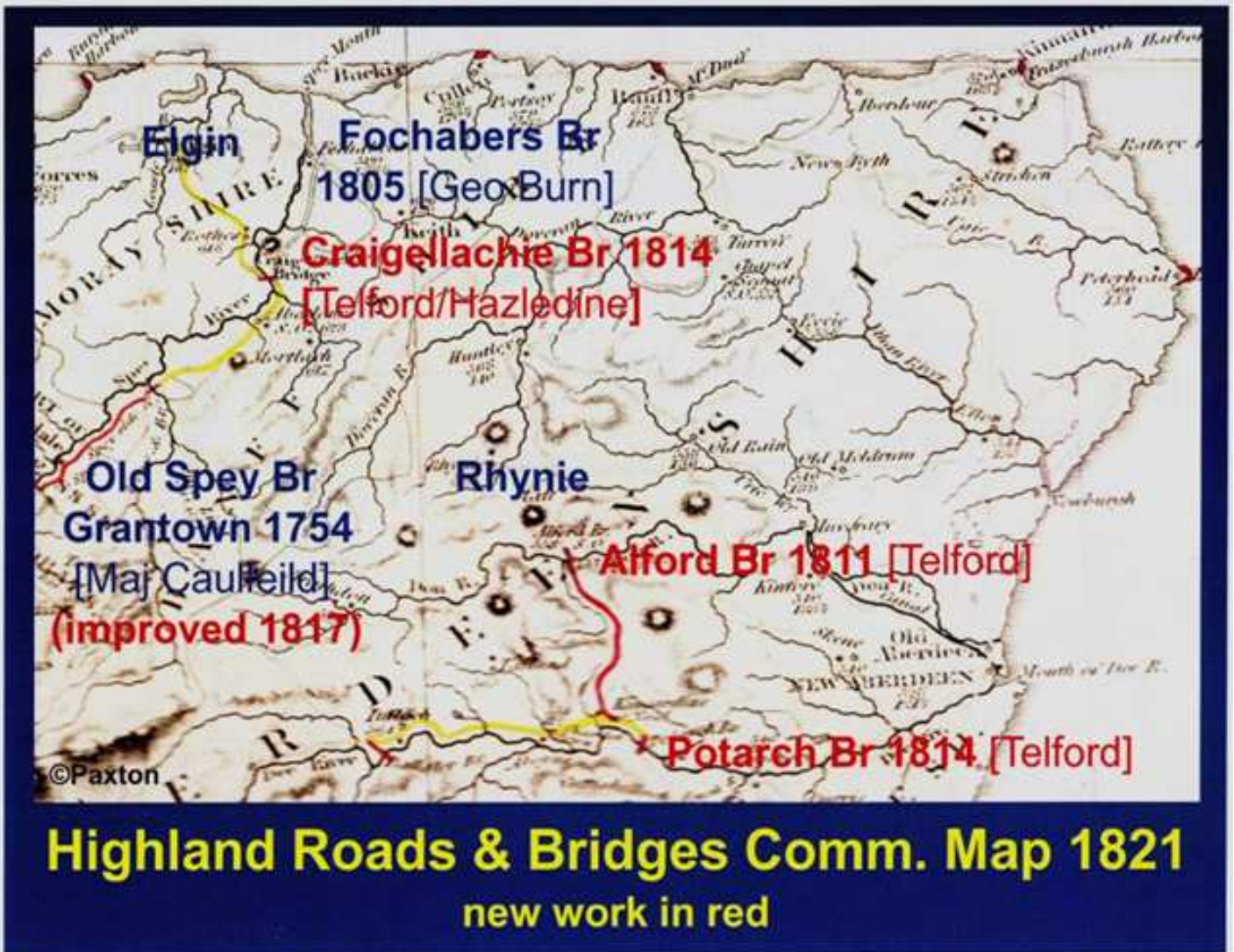
Fig.3 Arrol advertisement for 1963-64 reconstruction. Consulting engineers W.A.Fairhurst and Partners, Contractors Wm. Tawse Ltd and Sir Wm Arrol & Co. Ltd. [Private collection]



Fig. 4 Detailed inspection by Concorr in July 2014. ©Concorr



Dr Henry Petroski, American civil engineer and historian [L] and author at International plaquing 2007



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