The case for preserving Union Chain Bridge near Berwick-on-Tweed erected in 1820

To be presented at Paxton House at first meeting of the *'Friends' of the bridge* on 25 June 2014 at 7pm by

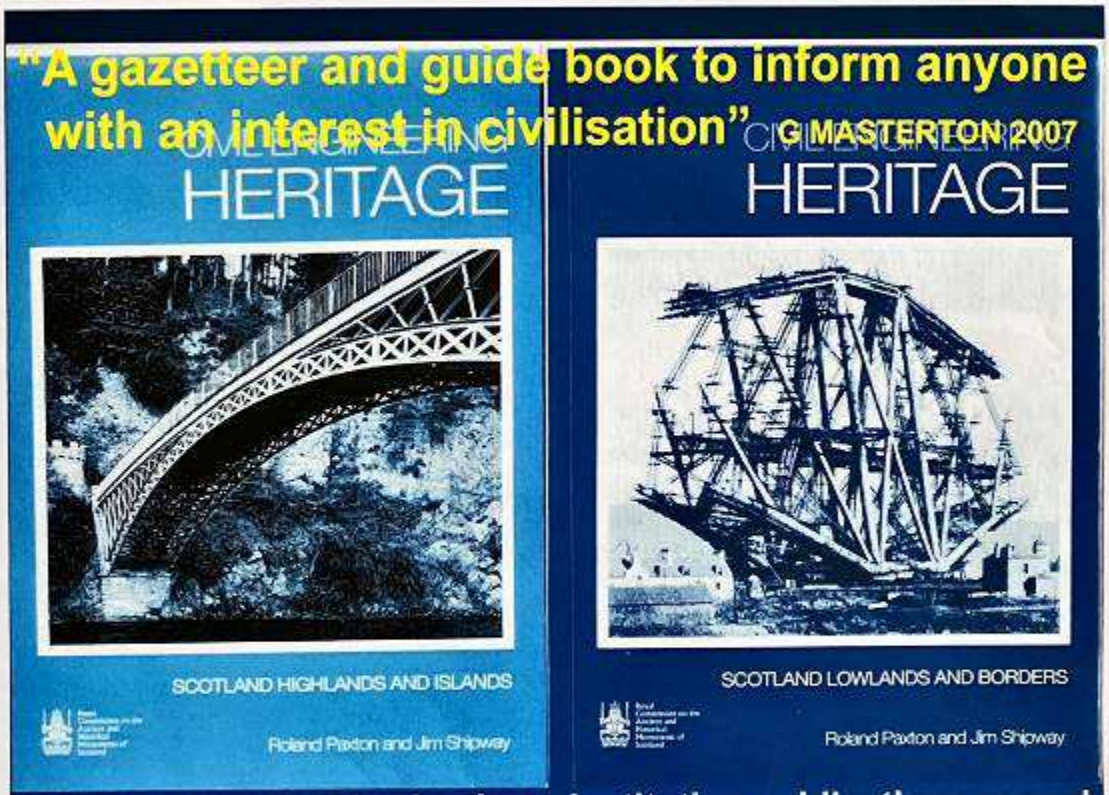
Prof/Dr **Roland Paxton** **MBE FICE FRSE** *Engineering Historian*

Hon Professor, School of Earth Science, Energy and the Built Environment, Heriot-Watt University
Vice-Chairman, Institution of Civil Engineers Panel for Historical Engineering Works
Member, Scottish Industrial Archaeology Panel

Society by and large treasures the best of its built heritage. In the UK this is a matter for English Heritage, Historic Scotland, local authorities, owners and others. In cases where original traffic usage has diminished, as at Union Bridge, it is difficult to justify costly specialist maintenance from the roads budget and understandable that its owners will seek additional funding to maintain an historic monument

In 2013 because of its deterioration Union Bridge was placed on English Heritage's *History at Risk Register.* My involvement in supporting its refurbishment is on behalf of the Institution of Civil Engineers via its Panel for Historical Engineering Works [PHEW – formed 1968] **which has a mission of 'encouraging excellence in conserving the finest examples of historical engineering works'**

"A gazetteer and guide book to inform anyone with an interest in civilisation" G MASTERTON 2007

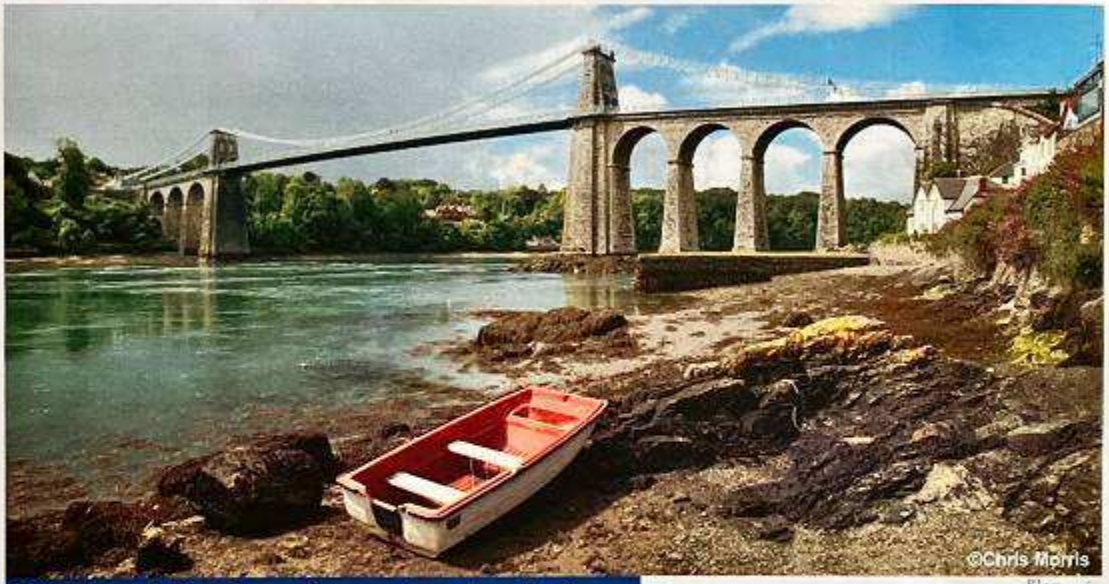


To help progress this aim these Institution publications record and place in context about 500 significant Scottish HEWs

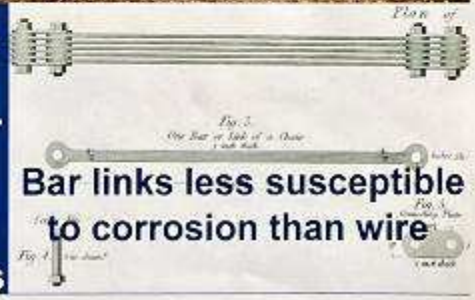
Of bridge types, suspension bridges are important as the means of achieving the longest spans. UNION BRIDGE has the distinction of a place in the progressive development of the world's longest, vehicle-carrying, spans i.e.

UNION, UK (1820) **437**ft
MENAI, UK (1826) **580**ft
WHEELING, Ohio R, W.Virginia, USA (1849) **1010**ft
BROOKLYN, USA (1883) **1596**ft
FORTH [exceptionally a girder bridge] (1889) **1710**ft
GOLDEN GATE, USA (1937) **4200**ft
HUMBER, UK (1978) **4526**ft
and today, **AKASHI STRAITS,** Japan (1998) **6532**ft

[*Guinness Book of Structures* – operational bridges]



At Menai Bridge Brown's single bar, round, link influenced a development of the concept by Telford i.e. a link of 5 flat bars in parallel – a mode used later at Hammersmith, Clifton, Budapest & Glasgow before the advent of steel wire cables



Bar links less susceptible to corrosion than wire

Akashi Straits, Japan 1998 – with high tensile steel cables and today's longest span of 1¼ miles

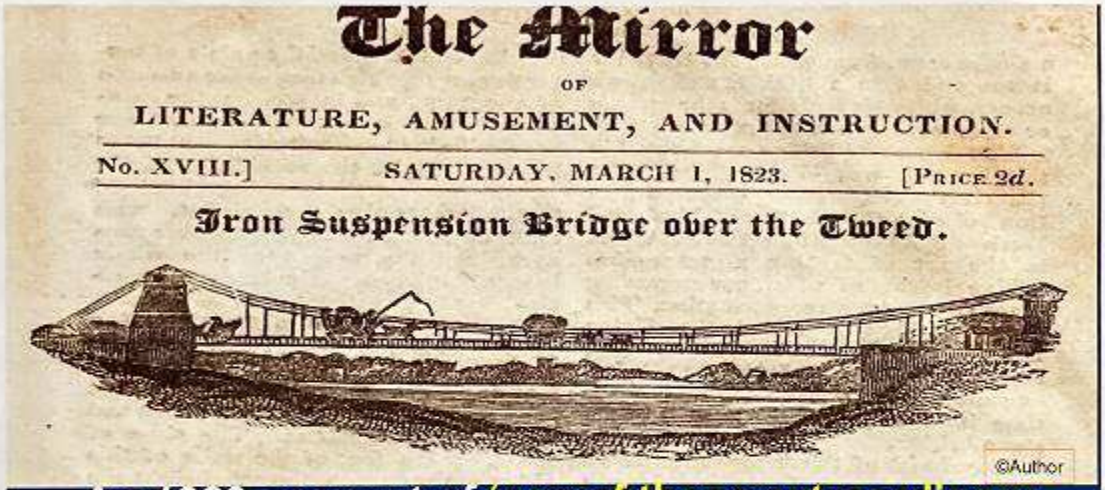
Union Bridge, over and above its local and visitor traffic usefulness, and from 1820-26 having had the world's longest span, deserves to be preserved as:

- **the world's oldest operational suspension bridge** and product of eminent British engineers [attributes contributing to its high level of statutory protection by *English Heritage* **[Class 1]** ; *Historic Scotland* **[Category A]**

- **a unique enhancement of the local environment**

- **an international landmark in bridge development**

- **an accessible display of outstanding bridge technology** [with educational and tourist potential]



The Mirror

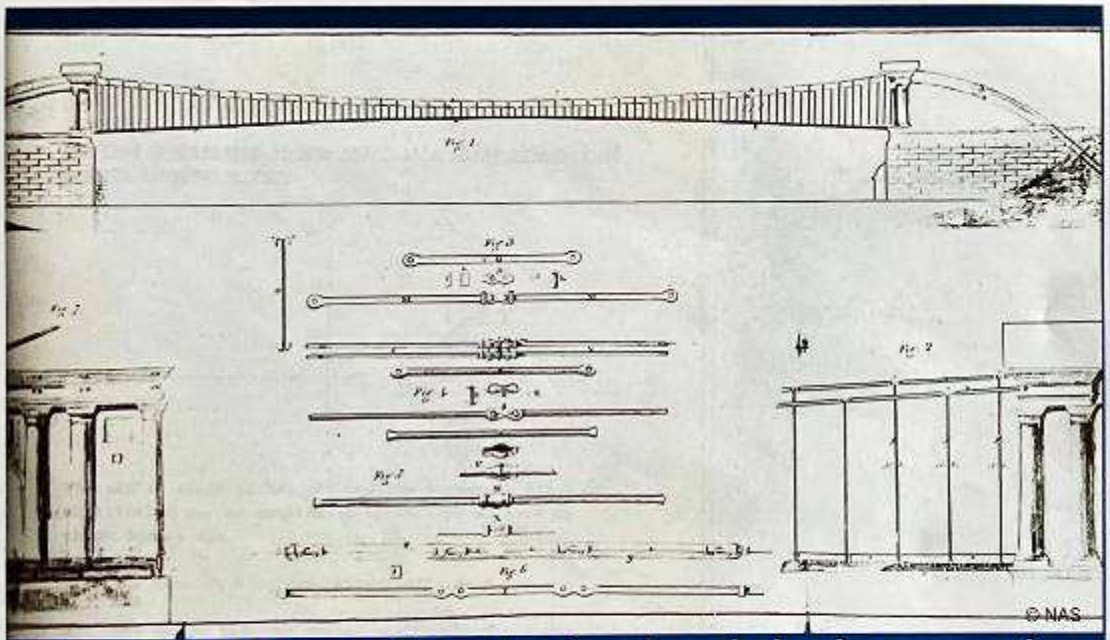
OF

LITERATURE, AMUSEMENT, AND INSTRUCTION.

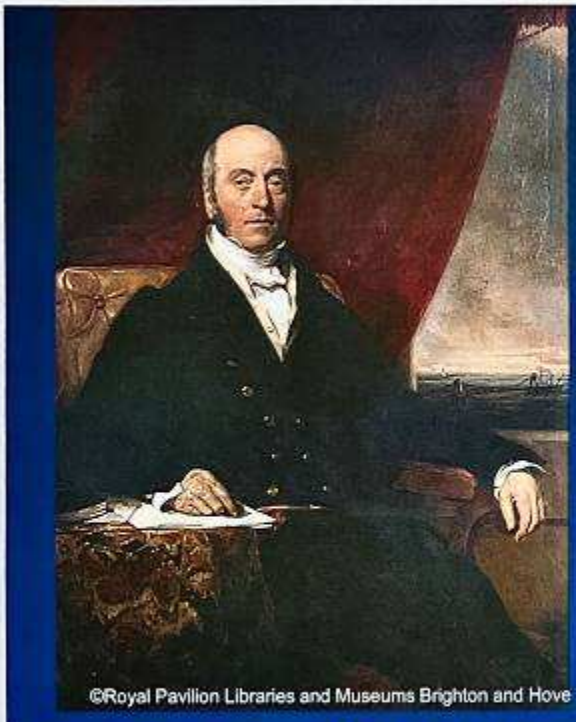
No. XVIII.] SATURDAY, MARCH 1, 1823. [PRICE 2d.

Iron Suspension Bridge over the Tweed.

An 1823 account of 'one of those extraordinary results of mechanical science which particularly distinguish the age in which we live … the whole works of the Union-bridge were undertaken by Capt Brown for about £5,000 - a stone bridge must have cost at least 4 times that sum' [based on R. Stevenson's *Description* 1821, published in German, French and Polish by 1824]



Brown's 1818 patent for using iron bar chains in suspension bridges, of which he became a leading exponent, erecting piers at Newhaven (Leith), and Brighton and bridges at Montrose, Aberdeen and Kalemouth. Re suspension bridge mechanics he took advice, in the case of Union Bridge, from John Rennie



Capt Samuel Brown (1774-1852) FRSE
Naval officer & chain manufacturer
at London & Newbridge, South Wales

John Rennie (1761-1821) FRSE
Civil Engineer

UNION BRIDGE ENGINEERS

Union Bridge in 2013. Span 437ft; dip 26ft

UNION BRIDGE Note state of bridge on 5 October 2013 and < one of four recent replacement hangers and caps to low chain pairs near mid-span

As refurbishment funding for Union Bridge has yet to be obtained it may be helpful in this and a public support context to review several Scottish projects of which PHEW has had experience:

'Innocent Railway' structures (1970s)
Forth Bridge (from 1986)
Gattonside Bridge (1991)
Carron Bridge over R. Spey (1993)
Laigh Milton Viaduct (1995-96)
Bridge of Oich, Aberchalder (1998)
Wellington Bridge, Aberdeen (1986-2006)
Linlathen Bridge East, Dundee (2004-12)
Craigellachie Bridge (2005-14)

The Innocent Railway

Interesting features of the original work which still exist are:

Inclined Plane
1,160 yards (1,060m) long, gradient 1 in 30 (3%).

This extends from St Leonards Depot, through the tunnel to the stables area located about 600 yards (550m) beyond the eastern portal. It was constructed in 1827-29 and equipped in 1830-31 with two 25 HP steam engines at the top of the incline. Descending trains were counter balanced by ascending trains.

[Cyclepath opened south of tunnel in 1982, to St Leonards in 1985, and through the tunnel in 1989. Conserved by Lothian Regional Council]

EDINBURGH AND DALKEITH RAILWAY
Inclined Plane (1831) — Vertical Profile

Tunnel
566 yards (518m) long, 20ft (6.1m) wide with semi-circular roof 15ft (4.6m) high at the centre.

This was constructed in 1827-29, and lined in Craigleith Stone. It was one of the earliest railway tunnels in the world.

New Civil Engineer 3 April 2003
Preservation of Braid Burn Bridge 1831 on *Edinburgh & Dalkeith* Railway

PHEW Exceptional Care Award

Historic bridge rescue wins commendation

THE RESCUE of an historically unique cast iron bridge, the only surviving remnant of the

or wood. When iron started to be used manufacturers couldn't make wrought iron on a sufficiently large scale and so used cast iron. This is a more brittle material, and there are few surviving examples," said Professor Roland Paxton, chairman of the ICE's panel for historical engineering works.

"The Braid Burn Bridge is made of four cast iron beams of a shape not known to remain in any other structure, so it was vital

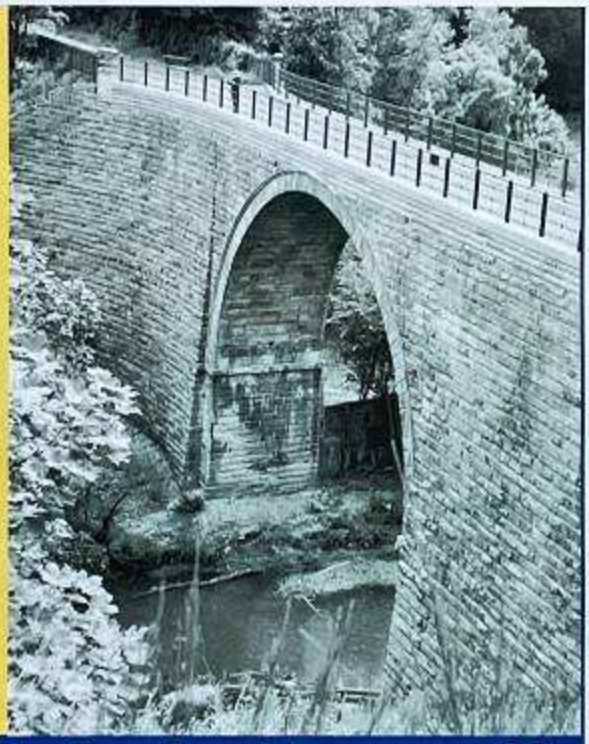
15

EDINBURGH
& DALKEITH
RAILWAY:
GLENESK BRIDGE,
DALKEITH.
The case for an
1829-31
date of origin.

Roland A. Paxton,
M.Sc., C.Eng., F.I.C.E.
Senior Research Fellow,
Heriot-Watt University

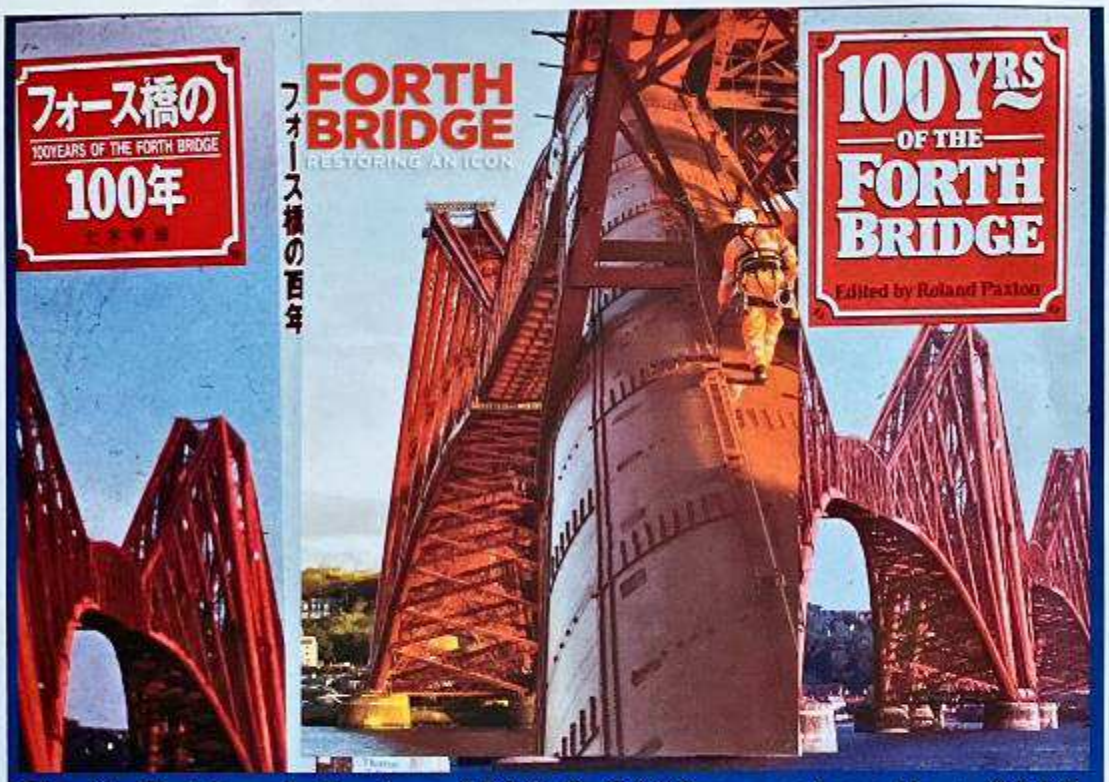
Offices

[1993 - resulting in category A listing]



Glenesk Bridge - 16 years older than thought – conserved in 1993 by Midlothian Council/Edinburgh Green Belt Trust

16



Forth Bridge tributes 1990 & £130m restoration 2012

PHEW initiated FBVC [1985-2012] press campaign 1995

17

NATIONAL DISGRACE: How part of our heritage is simply rusting away

EEN 12.10.1995

EXACTLY six months after the Evening News launched the hard-hitting "Paint Our Bridge" campaign, Railtrack has been forced to bow to public pressure. [full HSE survey ordered]

● **The key advice we received was:**

Although not in danger of falling down, rust was gaining hold and the proposed £500,000-a-year painting maintenance was not enough to guarantee the structure's long-term future.

We said in our front page editorial that day: "There is no longer any doubt. The future of Scotland's most famous landmark is under severe threat . . . "

We called for Railtrack – which inherited the bridge from British Rail – to be relieved of responsibility and for an independent trust to be set up.

That received almost unanimous backing – even embattled Railtrack, while insisting there was no threat to the bridge's structure in its hands, said it would welcome such a trust.

But we had started the ball rolling.

Our expert team included leading engineers, Heriot-Watt University Professors Roland Paxton and Paul Jowitt.

By James McGhee

CAMPAIGNING WRITER OF THE YEAR

Prof Jowitt summed up a nation's fears on the Maid of the Forth that day: "This is a fantastic structure, but it looks awful and its appearance does not encourage a lot of public confidence in the long-term future of the bridge."

Prof Paxton said: "I think the problem will get worse if they carry on at the present rate of spending."

At that time Railtrack said it would not even start painting the bridge's main supports for seven years, spending its £500,000 budget on more crucial latticework metal. With more than £1 million to be spent this year and a pledge to paint the main tubes at the same time as latticework, today's revelation is a clear victory.

But it took sustained campaigning, backed particularly by Prof Paxton and MPs Eric Clarke (Midlothian) and Tam Dalyell (Linlithgow).

18

Gattonside Bridge 'before & after' 1990 & 1992 – original ironwork preserved at ICE Museum, Heriot-Watt University

19

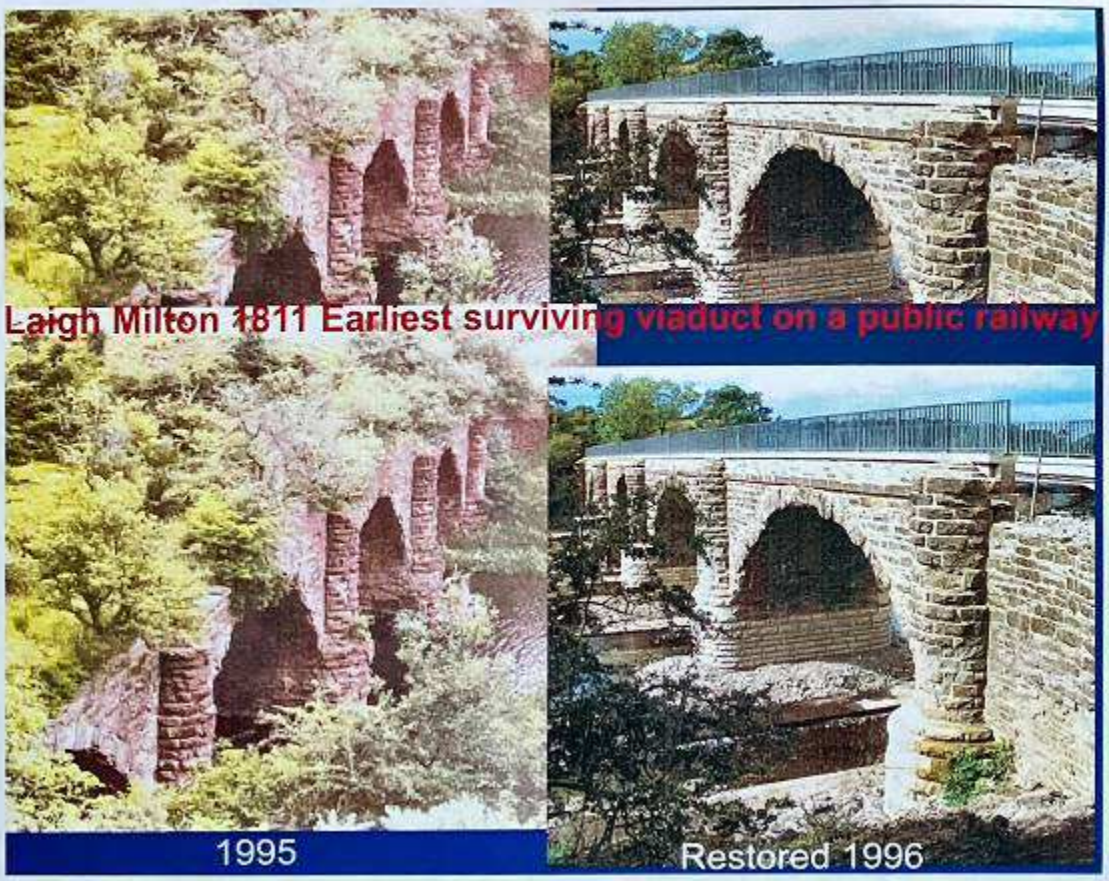
The Institution of Civil Engineers

Panel for Historical Engineering Works

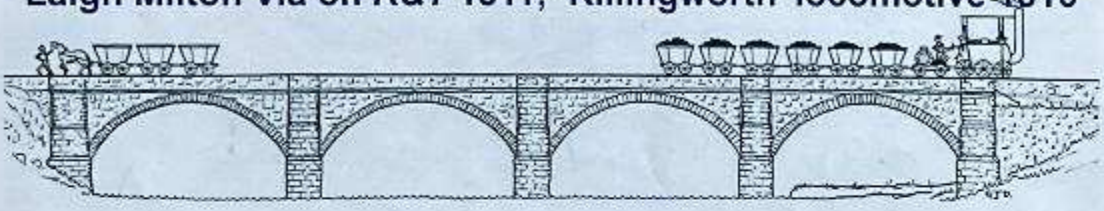
NEWSLETTER JUNE 1993 No.58

Carron Bridge 1863 150ft span over Spey – refurbished c.2000 Grampian Regional Council - PHEW support at Public Inquiry

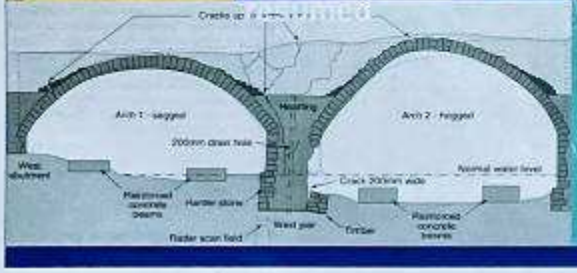
20



Laigh Milton Via on *K&T* 1811; 'Killingworth' locomotive 1816

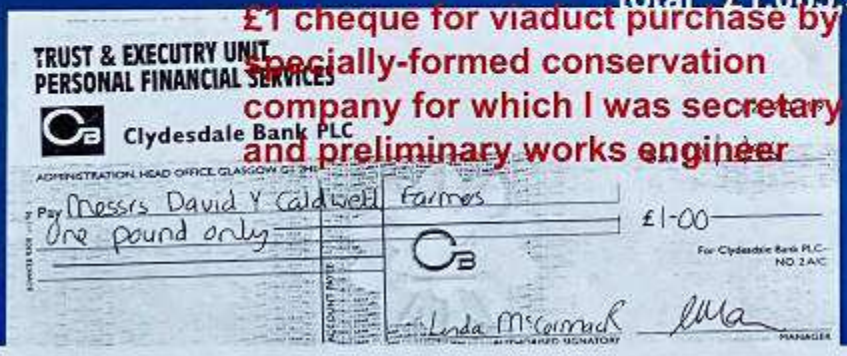


3ft iron plate rail of Jessop type fixed to 15x15x10in stones at each end
Rails broke under loco's vertical piston action and horse traction resumed



LAIGH MILTON VIADUCT FUNDING 1995

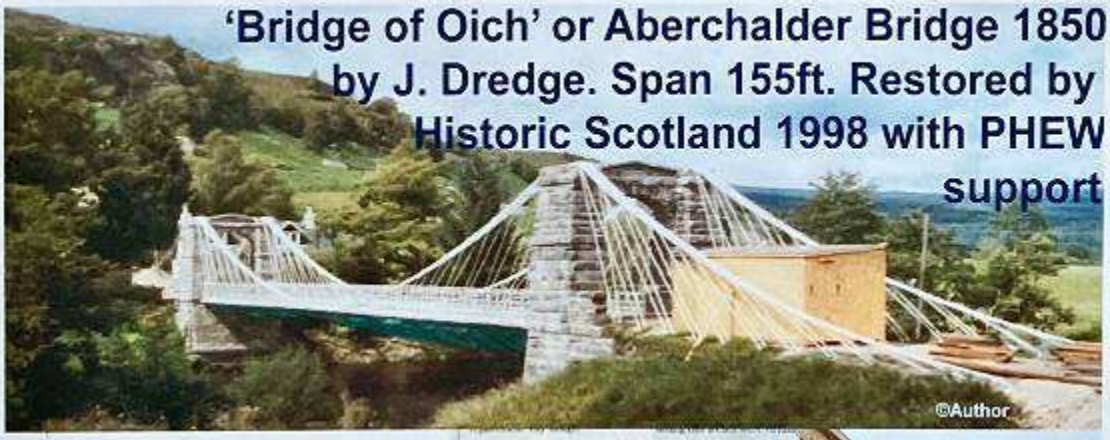
NATIONAL HERITAGE MEMORIAL FUND	£400,000
HISTORIC SCOTLAND	£277,300
EUROPEAN UNION (via SRC Planning)	£200,000
STRATHCLYDE REGIONAL COUNCIL	£63,000+
KYLE & CARRICK DISTRICT COUNCIL	£65,000
KILMARNOCK & LOUDOUN DISTRICT COUNCIL	£45,000
ENTERPRISE AYRSHIRE	£15,000
total	£1,065,300


TRUST & EXECUTRY UNIT
PERSONAL FINANCIAL SERVICES
Clydesdale Bank PLC
ADMINISTRATION HEAD OFFICE GLASGOW G1 2HL
Pay Messrs David Y Caldwell Farmers
One pound only
£1-00
For Clydesdale Bank PLC
NO 2 A/C
Linda McCormack
AUTHORISED SIGNATORY
MANAGER

£1 cheque for viaduct purchase by specially-formed conservation company for which I was secretary and preliminary works engineer

13

'Bridge of Oich' or Aberchalder Bridge 1850 by J. Dredge. Span 155ft. Restored by Historic Scotland 1998 with PHEW support



NCE 1989

Roland Paxton measuring the bridge at Aberchalder.

14

Wellington Suspension Bridge, Aberdeen 1830-1 (Capt. S. Brown). Conserved 2005 by Aberdeen Council

25

Thoughts on refurbishing Linlathen East Bridge, Dundee – Scotland's oldest surviving iron bridge?

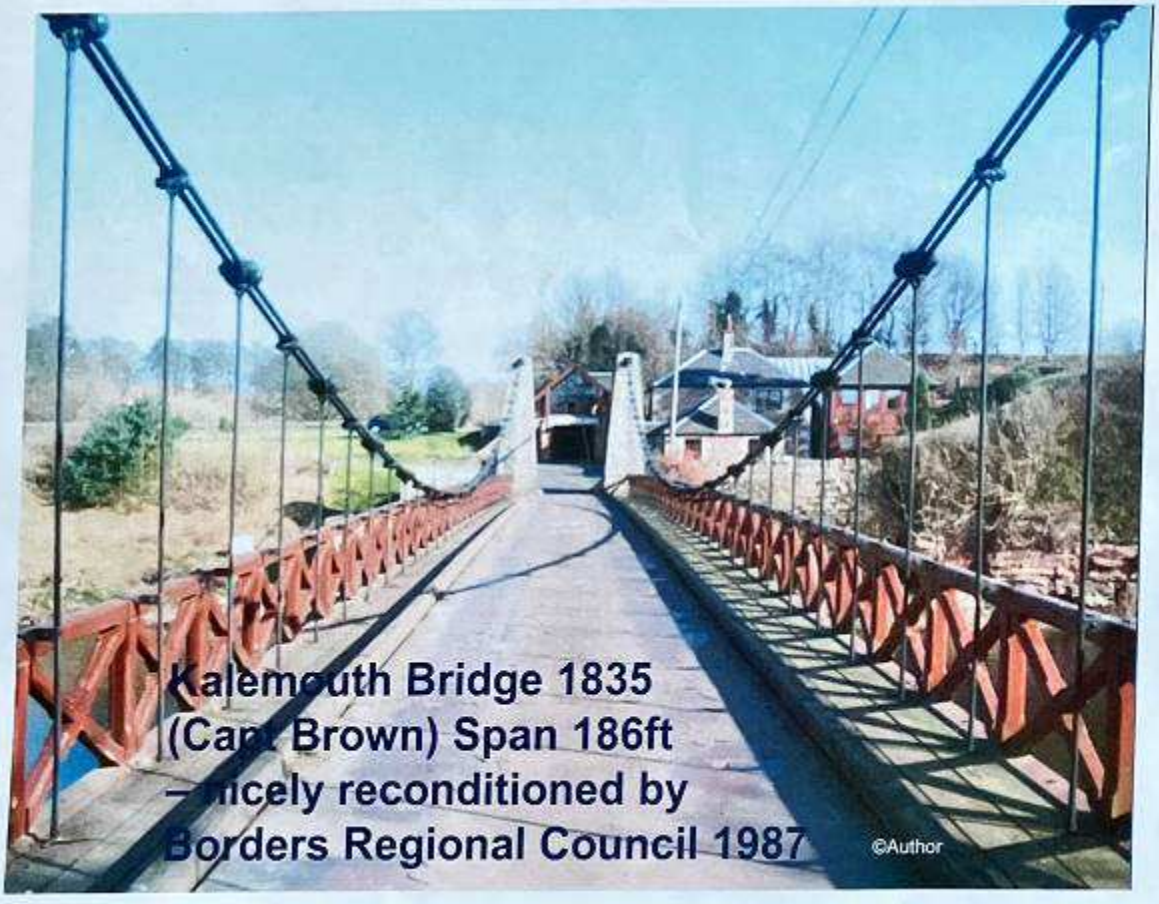
[Monograph 2004]

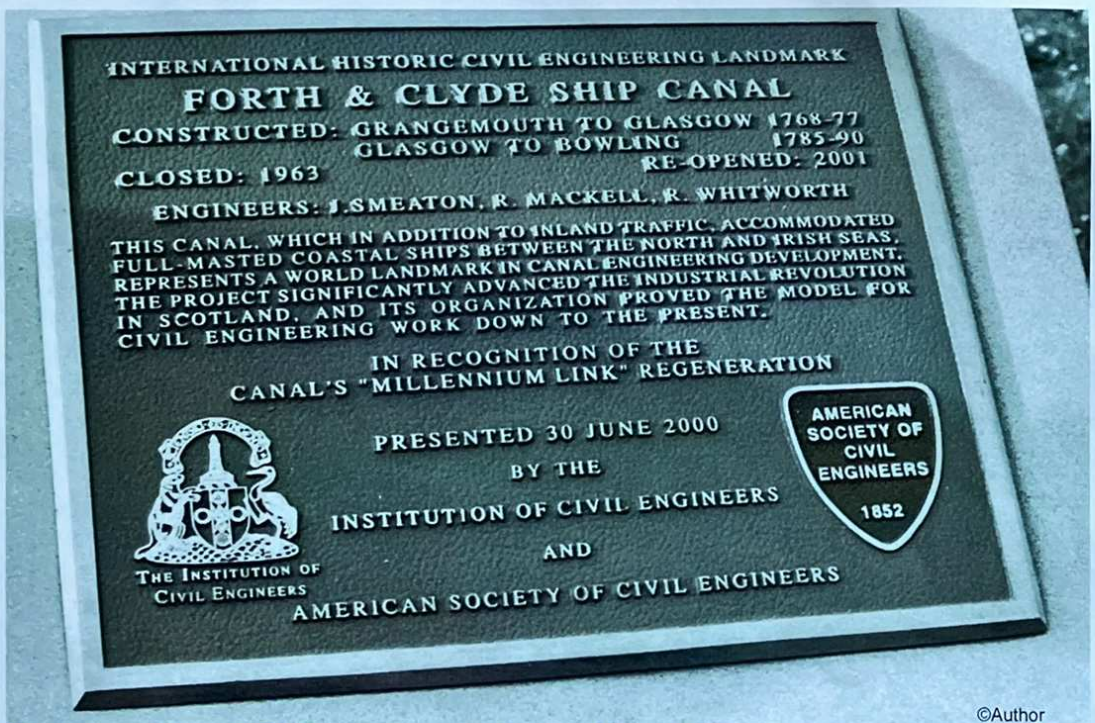
By **Professor Roland Paxton,** *Engineering historian and conservationist**

Presented to Dundee Civic Trust at Abertay University 29th January 2004

26


Linlathen East Bridge, Dundee c.1804. Conserved by Dundee City Council in 2012. Won national *Historic Bridge and Infrastructure Award 2012*
©Author

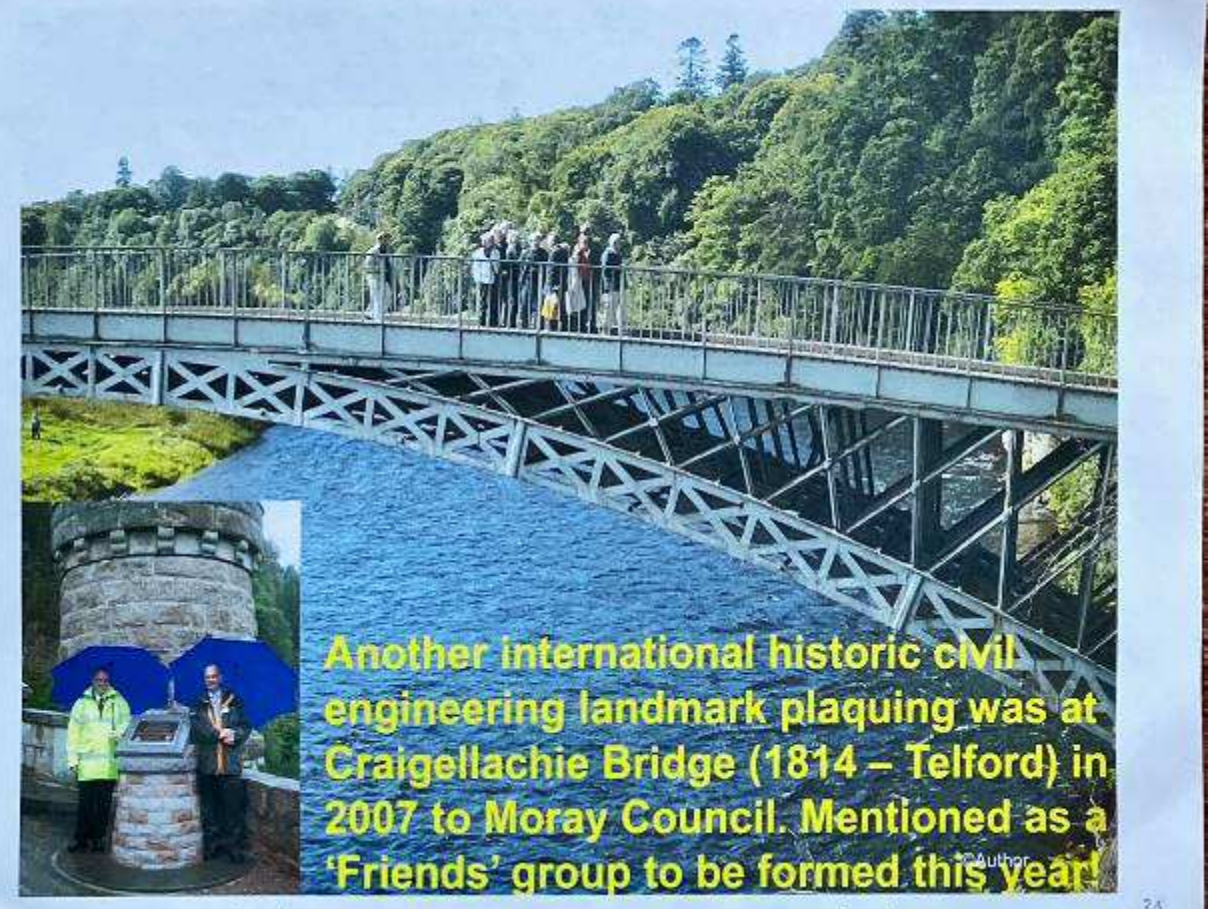

Kalemouth Bridge 1835
(Capt Brown) Span 186ft
–nicely reconditioned by
Borders Regional Council 1987
©Author



©Author

Outstanding HEWs with an international dimension such as the Forth Bridge, Forth & Clyde Canal were nominated to ASCE for HCEL status and led to prestigious plaque & unveiling events

29



Another international historic civil engineering landmark plaquing was at Craigellachie Bridge (1814 – Telford) in 2007 to Moray Council. Mentioned as a 'Friends' group to be formed this year!

©Author

30

An IHCELandmark plaquing in 2007 at Menai/Conwy, Wales (1826 - Telford, 327ft span) now conserved by National Trust

NORTHUMBERLAND

Northumberland County Council

County Hall • Morpeth • Northumberland • NE61 2EF • Web: www.northumberland.gov.uk

Professor R Paxton
Vice Chairman
Institution of Civil Engineers Panel for
Historical Engineering Works
Heriot-Watt University
Riccarton
Edinburgh
EH1[illegible]AS

Your Ref:
Our Ref: 10711
Enquiries to: Simon Rudman
Direct Line: 01670 622967
E-mail: Simon.Rudman@northumberland.gov.uk
Date: 27 January 2014

Dear Professor Paxton

Together with our colleagues from Scottish Borders Council we remain committed to securing the future of the structure with the ultimate goal of completing its refurbishment prior to the bicentennial celebration in 2020.

To conclude: The Institution recognises Union Bridge's outstanding significance; strongly supports the Councils' aims as below; welcomes the formation of the 'Friends'; and plans if owners consent to nominate the bridge as an International Historic Civil Engineering Landmark with a view to an ASCE/ICE presidential plaque unveiling at its bicentenary

Extract from NCC letter re. Union Bridge 27 Jan. 2014

PPP - *Edinburgh: School of Earth Science, Energy and the Built Environment EH144AS Scotland*
25 June 2014