1. Dumfries and Galloway

Introduction

Outstanding projects in this chapter include the 1930s Galloway Hydro-Electric Development (1-10 to 1-19) extending over hundreds of square miles and providing up to 102 MW of electricity; the Glasgow, Dumfries & Carlisle Railway 1846–50 with its tall viaducts, Drumlanrig Tunnel and the massive Enterkinfoot retaining wall (1-32-35); and the Glasgow & Carlisle Road (1815–25, 1-40-44), the equivalent of a modern motorway, with its many bridges and Beattock Inn service area.

Maritime engineering is represented by lighthouses at Southerness (1749, 1-26); Mull of Galloway (1828, 1-1); Corsewall (1816, 1-5); Port Logan (1820, 1-2), with its mole; Port McAdam and Fleet Canal (1824–1840, 1-8); and, at Portpatrick, where constructing the harbour gave Smeaton and Rennie much trouble from storm damage (1-3). Mention is made of Barton's ambitious proposal for an Irish Channel tunnel crossing in 1901.

Masonry bridges represent about 40% of the entries. Notable examples are the 15th century Devorgilla, Dumfries (1-29); Tongland, (1808, 1-9) where Nasmyth did not have as much influence on Telford's design as is often thought; Rennie's fine Cree 1814 and Ken examples (1824, 1-6 & 1-20); Threave (1825, 1-25); and Stevenson's Annan Bridge (1827, 46).

Iron bridges include Creel, ca.1840, now ruinous but probably the earliest truss bridge of its type in the area; Dumfries suspension (1875, 1-27); Raehills trussed-timber (1-39); and bow truss examples at Loch Ken (1869, 1-21) and Kirkcudbright (1868–1926, 1-9).

Reinforced concrete work features at Kirkcudbright Bridge (1926, 1-9); the Arrol-Johnson Works, Dumfries (1913, 1-31); and at Baltersan grain silo (1920, 1-6).

Minor works included because of their association with the Eskdale-born eminent civil engineer Thomas Telford are: Langholm Bridge and his father's gravestone (1-48); Westerkirk Parish Library partly funded by his bequest (1-50); and the monument to his friend Sir John Malcolm on Whita Hill (1-51).

Unusual works are the Laird's Bay Cable Testing House for the undersea telegraph cable between Scotland and Ireland (1852, 1-4); Knockenjig Waste Treatment Plant at Kirkconnel (1953, 1-38); and the eight-seater Parton Privy (1901, 1-21)!

Northern Lighthouse Board

Mull of Galloway Lighthouse

1. Mull of Galloway Lighthouse

HEW 1015
NX 1569 3039

This lighthouse was built in 1828 for the Northern Lighthouse Board by Edinburgh contractors Brebner and Scott, to the design and under the direction of Robert Stevenson for about £9000. The stone tower is 70 ft high and stands above cliffs 260 ft high. The light was first exhibited in 1830 and was novel in operating as an 'intermittent' light by means of the sudden closing and opening of two intersecting opaque drums enclosing the apparatus which were moved vertically in opposite directions by machinery. Changes were made to the light through the years and in 1971 the tower was modernised and electricity installed. The fog horn, now disused, dates from 1894. [1]

2. Port Logan Mole and Lighthouse

HEW 1277
NX 0947 4056

Roy's map of Scotland ca.1755 indicates a small pier at the south arm of Port Logan Bay, but by 1791 the harbour was in ruins. In 1813 John Rennie reported favourably on the site in preference to Portpatrick as a harbour for the Irish packet traffic.

In 1820, a pier or mole extending 540 ft in an easterly direction was built by Colonel McDoull of Logan and the remains of a jetty structure at the south arm of the bay correspond to the proposals in Rennie's report. There is a pier head and a light tower with a lantern and a bell-cote roof. The area enclosed by the jetty and the pier is about three acres.

Roland Paxton

Port Logan Mole and Lighthouse

The three storey lighthouse is about 25 ft high, circular in plan and 10 ft diameter. The mole and lighthouse were repaired and refurbished in the 1980s. [2]

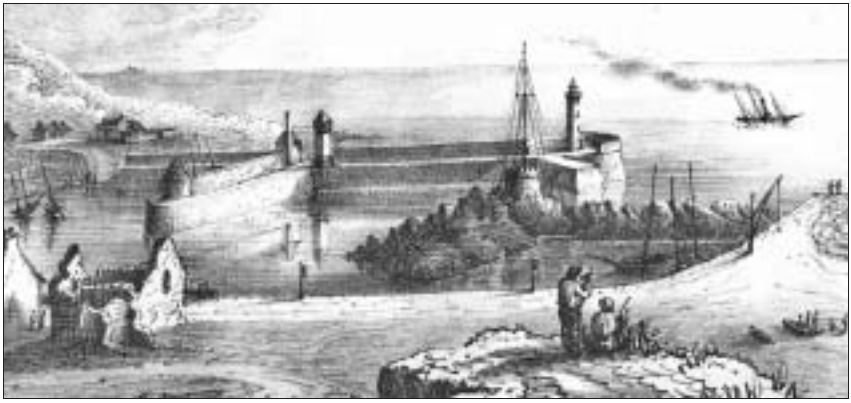
3. Portpatrick Harbour

HEW 1276
NW 9987 5410

Portpatrick to Donaghadee was a trade route between Scotland and Ireland from earliest times and there have been several attempts to construct a substantial harbour.

In 1768 John Smeaton proposed two breakwaters, north and south, the latter being completed in 1778. Efforts to build the north breakwater proved abortive due to the destructive action of the sea and finally abandoned in 1801. Telford was consulted in 1802 and found Portpatrick 'destitute of the advantages requisite for a perfect harbour', an opinion which was borne out by events.

Rennie was of the opinion that a satisfactory harbour could be made and, in 1818, produced a plan modelled on Smeaton's for two massive piers and a lighthouse estimated to cost about £120 000. Two years later work began. An eye witness 'saw 700–800 labourers digging, quarrying, trundling barrows and building by night and day in the light of



Portpatrick Harbour ca.1850 [Clarke, J. *The wreck of the Orion*. 1851]

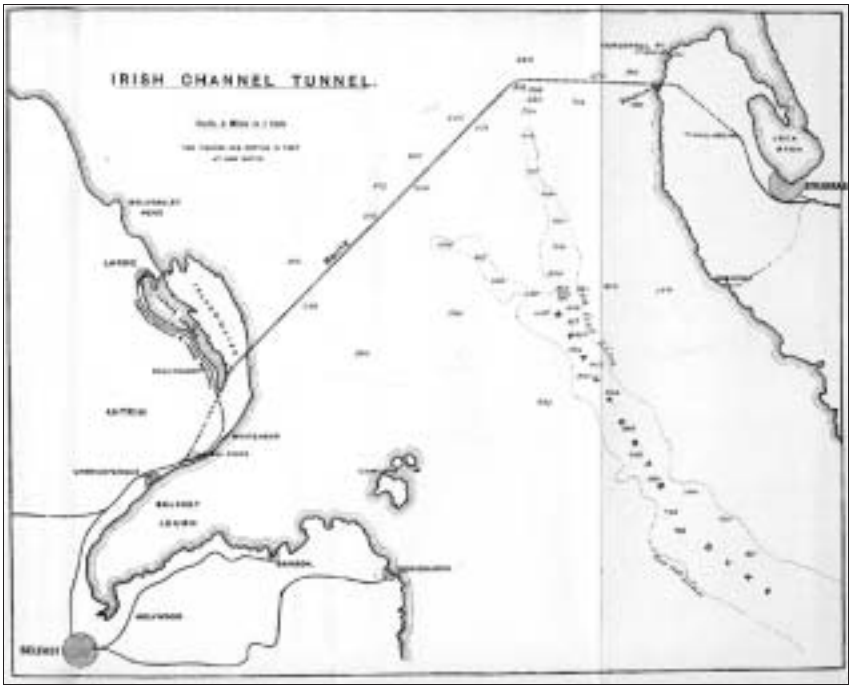
blazing coals heaped up in cradle grates. He saw too the thousands of tons of Dumbartonshire freestone, Anglesey limestone, local whinstone and granite which was used in constructing breakwaters and piers. While work proceeded the din of the ocean was stilled by the clang of hammers, the suction of pumps, the hissing of boilers and the roar of bellows.' The south breakwater with its lighthouse was eventually completed in 1836, but the north pier was unfinished.

In 1839 a storm undermined the end of the south pier, endangering the lighthouse and causing £13 800 worth of damage, by which time costs on the project had exceeded £170 000. In 1849, when the Irish mail service was transferred to Stranraer, the extent of the harbour was as shown.

After the Portpatrick Railway Act was passed in 1857, an inner basin was excavated to the north of North Harbour, mainly in rock, to accommodate Irish Packet traffic. The railway arrived in August 1862 but the mail service never fully resumed at Portpatrick and after 1873 the harbour was abandoned. The lighthouse, redundant by the 1860s, was dismantled and re-erected at Colombo, Ceylon, now Sri Lanka, in 1871.

The inner harbour is now privately owned and managed, and well used by fishing and pleasure boats.

In 1901 details of a proposed alternative means of communication via an Irish Channel Tunnel were put forward by engineers Sir Douglas Fox and James Barton. They favoured the northernmost of three lines examined, involving a £10 million, $35\frac{1}{2}$ mile tunnel from Stranraer to



Irish Channel tunnel proposal 1901 [5]

Carrickfergus, of which 25 miles would have been under the sea. The project was considered practicable but funding was not forthcoming. [3–5]

4. Laird's Bay Cable House, Port Kale

HEW 1023
NW 9912 5526

This purpose-built cable house adjoining the beach one mile north of Portpatrick, was constructed in 1852 to house apparatus for testing the telegraph cable laid between Scotland and Ireland. Because of difficulty in obtaining cable, a second line between Portpatrick and Donaghdee was not completed until 1853. These cables were superseded and lifted in 1983.

The cable house is double hexagonal in plan with rendered walls, masonry quoins and a pointed tiled roof. It is on the Dunskey Estate and now disused. The cable laying contractor was Newall & Co. of Gateshead and the cable was made by the Magneto Electric Telegraph Co. Ltd. [6]

R. R. Cunningham

Laird's Bay cable house and marker

5. Corsewall Lighthouse

HEW 2412
NW 9807 7261

This lighthouse was built by contract at the northern tip of the Rhinns of Galloway for the Northern Lighthouse Board from 1815–16. Its masonry tower is 110 ft high. The engineer was Robert Stevenson.

On his inspection voyage in December 1815, Stevenson noted that building operations were going on with all speed and that the first stage of the tower, 30 ft high, and a part of the dwelling house were being built. His specification for the light, published in local newspapers in October 1816 advertised 'The light will be from oil with a reflecting and revolving apparatus . . . light of natural appearance alternating with red'. This was one of the earliest applications of this distinction.

The lighthouse was modernised in 1891 and 1910. Since the lights were automated much of the former lighthouse station now serves as a hotel. [7]

Top: Cree Bridge [photograph 'W.H.' ca.1900]

6. Cree Bridge, Newton Stewart

HEW 0943
NX 4115 6565

This elegant five-span arched masonry bridge over the Cree was designed by Rennie and built from 1812–14. The inspector was John Hall, the contractor, Kenneth Mathieson and the cost £8234. The outer spans are 38 ft 6 in., the inner spans 45 ft 9 in. and the centre span is 50 ft, all segmental in elevation. The bridge is low over the water and the centre arch has a rise of only 6 ft 6 in. The width between parapets is 20 ft.

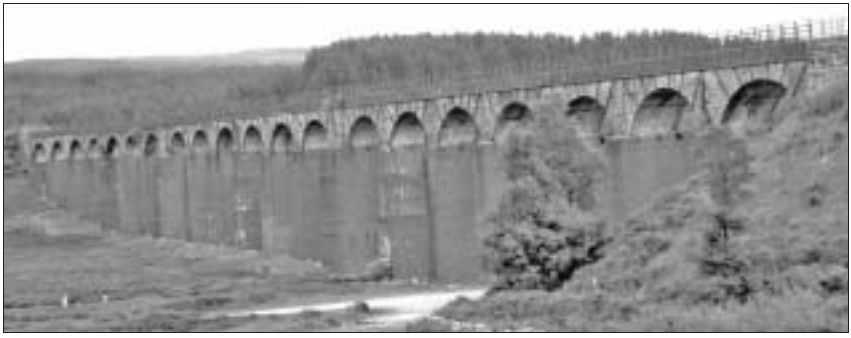
The masonry is of rough-faced granite. Above the pointed cutwaters, semi-octagons of masonry are carried up to parapet level forming pedestrian refuges. Rennie narrowly escaped death when scaffolding collapsed while he was making an inspection of the bridge during its construction. The bridge formed part of the Carlisle to Portpatrick turnpike road, but is now bypassed.

Two miles south of the town, adjoining the A714 at Baltersan (NX 4230 6140) is one of the earliest reinforced concrete grain silos in Scotland built in 1920, now disused. Internally it is 100 ft high and 14 ft diameter with a battlemented top. There is an outside ladder in a protective external shaft. The walls are 6 in. thick and the concrete was placed in 2 ft lifts. The contractor was James Scott & Son (Aberdeen) Ltd. [8, 9]

7. Big Water of Fleet Viaduct, Gatehouse

NX 5591 6433

This massive viaduct strides across the Big Water of Fleet. It was built in 1861 as part of the Portpatrick Railway. The engineers were B. & E. Blyth, Edinburgh.



Michael Jones

Big Water of Fleet Viaduct

The bridge, a masonry structure of 20 segmental arches, featured in the 1935 film version of John Buchan's novel *The 39 Steps*. It developed cracks, presumably because of ground settlement, which necessitated the piers being given an unsightly casing of brickwork up to the springing level of the arches in 1924. The arch spandrel walls were themselves strengthened with tie rods and rails. The line closed in 1968 and the viaduct is now disused and owned by Sustrans, the Cycle Network Project.

8. Port McAdam and Fleet Canal, Gatehouse of Fleet

HEW 2429
NX 5947 5577

The Water of Fleet between Gatehouse of Fleet and the sea was navigable before the canal era, but a small canal scheme was constructed from June to October 1824 to improve the navigation and reclaim land previously covered at high tide. The canal straightened out river meanders and was 1400 yd long. It accommodated the passage of vessels of up to 160 tons and is now used for leisure pursuits.

The landowner Alexander Murray's factor, Alexander Craig, showed innate engineering acumen in forming the canal by directing 200 Irish labourers to dig a trench along its line of nearly the depth to which it was to be excavated and then turning the river into the trench. This procedure scoured by tidal action a channel of the exact width and depth required in only two days at a cost of £2204 3s 5d, a big saving on the estimate by 'an eminent engineer at about £5000'. The natural occurring rock

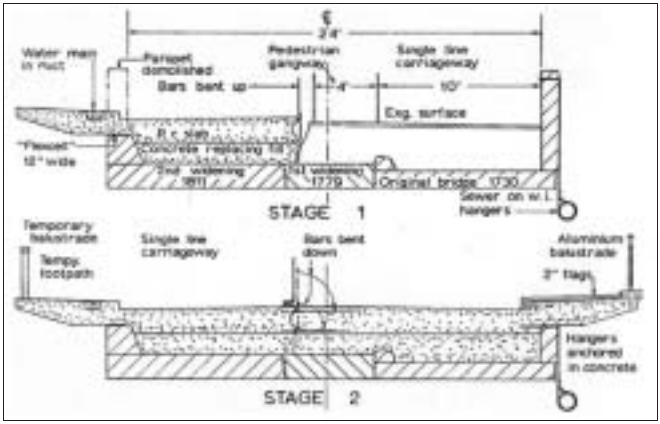
Fleet Canal from A75

Ken McCrae

abutments of a former canal swing bridge can be seen just north of the present A75 bridge.

Some 600 yd below Fleet Bridge in Gatehouse of Fleet, a quay was built by David McAdam, a local ship agent who in April 1838 had obtained permission from Murray to erect it and levy a tonnage charge. It became known as Port McAdam and was profitable by the mid-century but now no longer exists. [10, 11]

Fleet Bridge is of historical interest in having been rebuilt at least twice and widened three times. It existed as a timber bridge in the 16th century, was rebuilt in timber ca.1661, and washed away in 1721. In 1730 it was replaced by the present stone bridge with two 29 ft span arches, which was widened in 1779, 1811 and again in 1964 as shown in the cross-section. [12]



Fleet Bridge cross-sections 1730–1964 [12]

9. Tongland Bridge, Kirkcudbright

HEW 0206
NX 6920 5334

Tongland Bridge now carries the A711 about 60 ft over the Dee near Kirkcudbright. It was projected in 1803 and built from 1804–08 to link the port of Kirkcudbright with Ayrshire, Dumfries and Portpatrick, and its cost of £7710 was financed mainly by the Stewartry's Commissioners of Supply, with £1100 from public subscription. It comprises a single segmental arch of 112 ft span with a rise of 32 ft, flanked by three narrow pointed Gothic arches on each side, and is built mainly in rough-faced grey sandstone from Arran on which stone duty was charged. The interior part of the arch is formed of a red sandstone from Annan.

The bridge was planned and designed by Telford, with a significant input to its external appearance from artist/architect, Alexander Nasmyth. It was contracted for by country masons Sam and Alex McKean, S. Hyslop and A. McGuffery in late 1803 and the foundation stone laid in March 1804. But the timber centring to carry a 133 ft arc of arch-stones $3\frac{1}{2}$ ft deep for one of Britain's largest spans proved beyond the masons' skills and was demolished by flood water in August 1804.

Telford was called in to remedy matters. The contractors were relieved of their obligation to build the bridge for what he considered the 'quite impossible' price of less than £3000, and Adam Blane was brought in as resident engineer. Under Blane's direction the arch-ring was completed by day labour, using the centring shown, on 29 August 1805 and the whole bridge by 21 May 1808. The bridge was passable from November 1806.

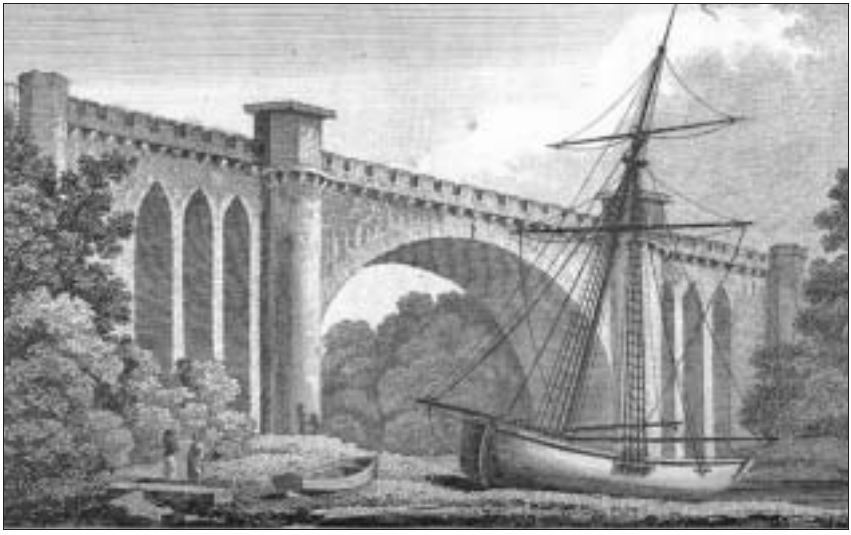
The bridge is of particular interest as Telford's earliest large span masonry arch and for his use of hollow spandrels to obviate outward pressure from internal fill, to reduce the weight on the foundations, and to facilitate inspection. Four slabbed-over cavities, wide enough to accommodate a man, run longitudinally. Although Telford did not invent this concept (see 6-16, Perth Bridge), he developed and promoted it for large spans using Tongland as an example in his landmark 'Bridge' treatise in the *Edinburgh Encyclopaedia* from 1812. More locally he would have been aware of their use at Gilnockie Bridge (NY 3860 7815) with its handsome 70 ft main span

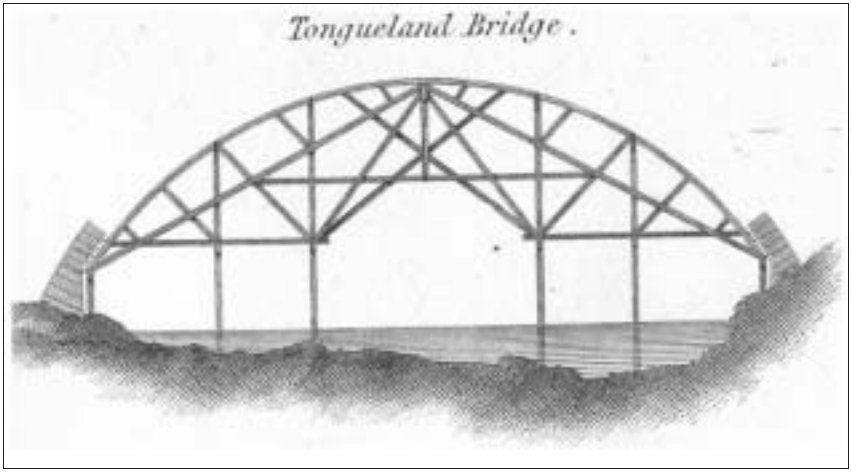
Tongland Bridge as built (Telford) [photograph ca.1880]

and rise of about 25 ft built in ca.1800 at Hollows adjoining the Carlisle road four miles south of Langholm.

As an admirer of the Gothic style, Telford would have been pleased to include in his plan the turreted and embattled elevation in rustic-style masonry of Nasmyth's design. Between the main span and the pointed arch side spans, semi-circular cutwaters extend as turrets to parapet height, forming pedestrian refuges at road level. The parapet is corbelled out but, as can be seen from the comparison of the photograph and Nasmyth's drawing, Telford did not adopt Nasmyth's castellation over the side spans or his eight octagonal towers above stringer level.

Tongland Bridge – Nasmyth's elevation [18]





Tongland Bridge centring used by Blane in 1805 [17]

The bridge was strengthened in the mid-20th century with the provision of a reinforced concrete slab across the tops of the hollow spandrel walls.

The next major bridge to be erected over the Dee, $1\frac{1}{2}$ miles downstream at Kirkcudbright, was a wrought iron bow truss bridge, with five spans of 71 ft and an opening span of 93 ft, erected in 1868. The engineer was H. J. Wylie and the contractors, Hopkins, Gilkes & Co., Middlesbrough.

Kirkcudbright Bridge 1868–1926 [postcard ca.1910]

The bridge plates from its curved approaches can be seen at the entrance to Kirkcudbright Museum.

This bridge was replaced in 1926, retaining the original lamp standards, by the present five-span reinforced concrete bowstring bridge of similar appearance engineered by Blyth & Blyth and L. G. Mouchel & Partners. It is a slender and notable example of its type from the era when it was fashionable to reproduce confidently traditional bridge types in the new material, even a suspension bridge at Montrose! [13–18]

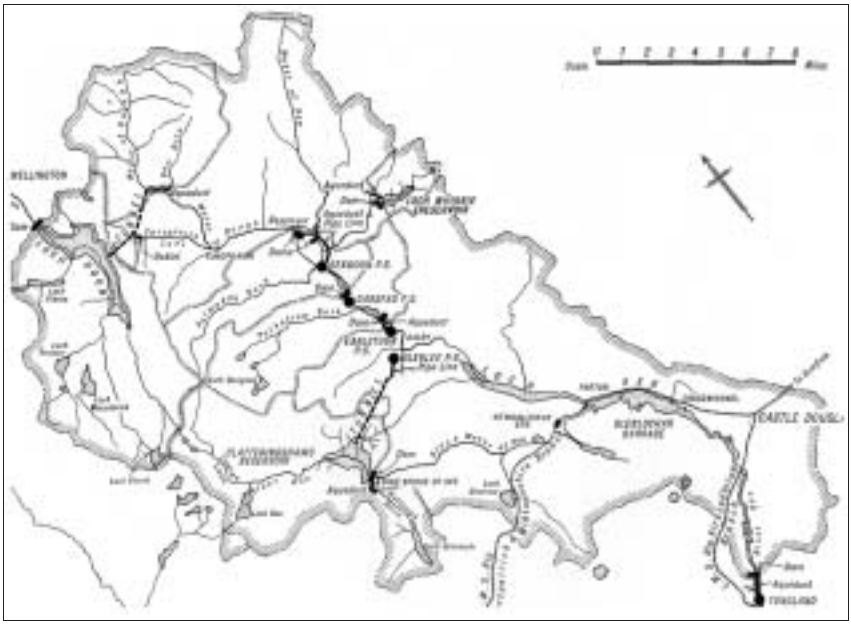
Galloway Hydro-Electric Development

HEW 1457

The Galloway Water Power Scheme, as it was first named, was designed to produce power for the grid in south-west Scotland. Also, to accommodate peak loads in order that the load factors of other power stations in mid-Scotland and northern England might be improved. Its plant, therefore, was not intended to be in continuous operation, except when the rivers which supplied it were in spate, and its annual output is low comparative to the installed plant capacity.

The maximum output was planned to be 102 MW and this was achieved. The catchment area lies mainly in Kirkcudbrightshire, but includes a small area in Ayrshire, and has a length of about 39 miles and a maximum width of 19 miles, reaching almost to the sea at Kircudbright and extending northwards to the hills south of Dalmellington. The average annual rainfall for the area is 40–50 in. The major part of the catchment is drained by two rivers, the Galloway Dee and the Water of Ken, together with their tributaries. A subsidiary part of the catchment includes the Doon, which is collected in Loch Doon and diverted by tunnel into the Dee.

The size of the area and the general tendency of the ground to slope towards the south did not allow the water to be gathered into a single reservoir. Instead the development includes five power stations utilising the flow of water in the valleys, the lowest one alone making use of the water from the whole catchment. These power stations,



Galloway Hydro-Electric Development map [19]

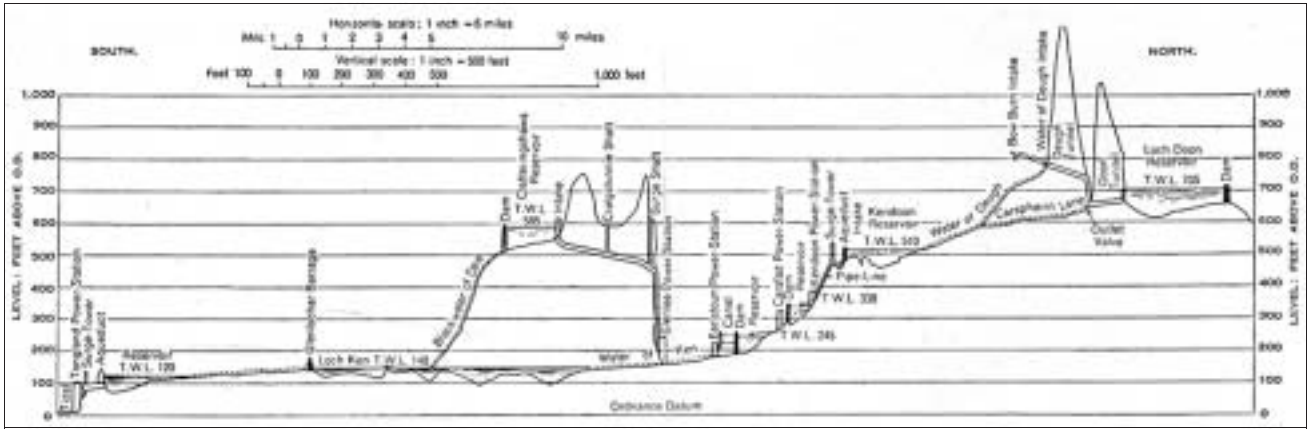
in descending order, are Kendoon, Carsfad, Earlstoun, Glenlee and Tongland. All except Glenlee were planned to be in operation for 5–8 hours out of 24, except during floods, mainly using water from Loch Doon. As can be seen in the section most of the water is used several times before reaching Tongland Power Station.

Dams were required at Loch Doon, Water of Deugh (two), Loch Whinnie, Carsfad, Earlstoun, Clatteringshaws and Tongland, eight in all, plus the Glenlochar Barrage. Several intakes and tunnel aqueducts were also required. This massive scheme 'conceived by William McLellan' was constructed in two stages, beginning in 1931 with completion in 1937. The consulting engineers were Sir Alexander Gibb & Partners and Merz & McLellan.

The power station at Glenlee is on a separate arm of the scheme and draws water from Clatteringshaws Reservoir through a tunnel 3.6 miles long.

The capacities of the power stations are as follows:

Kendoon – 21 MW (Head 150 ft) (NX 6054 8779)
Carsfad – 12 MW (Head 65 ft) (NX 6056 8544)
Earlstoun – 12 MW (Head 67 ft) (NX 6141 8188)



Longitudinal section from Loch Doon Reservoir to Tongland Power Station [20]

Roland Paxton

Tongland Power Station – turbo-alternator hall

Glenlee – 24 MW (Head 380 ft) (NX 6060 8056)
Tongland – 33 MW (Head 106 ft) (NX 6951 5356)

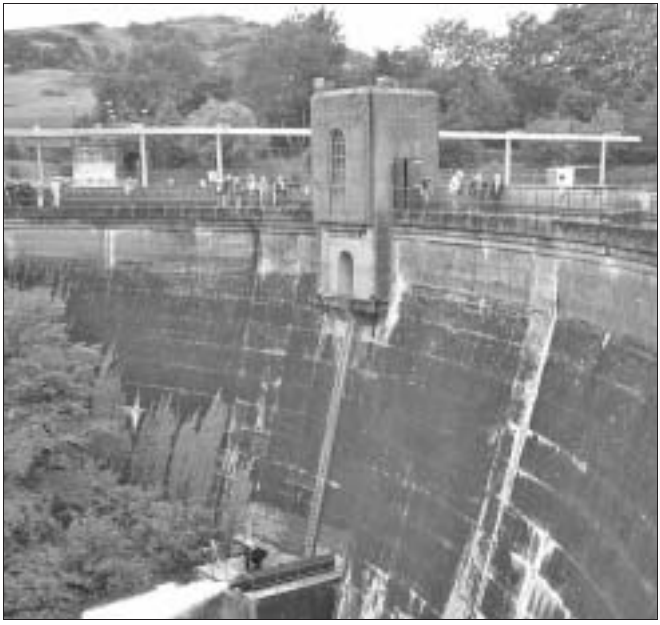
All the power station sub-structures are constructed of reinforced concrete within the building's steel frame, and exhibit faithfully the engineering architecture of the 1930s. [19, 20]

10. Tongland Dam

HEW 1457/02
NX 7023 5448

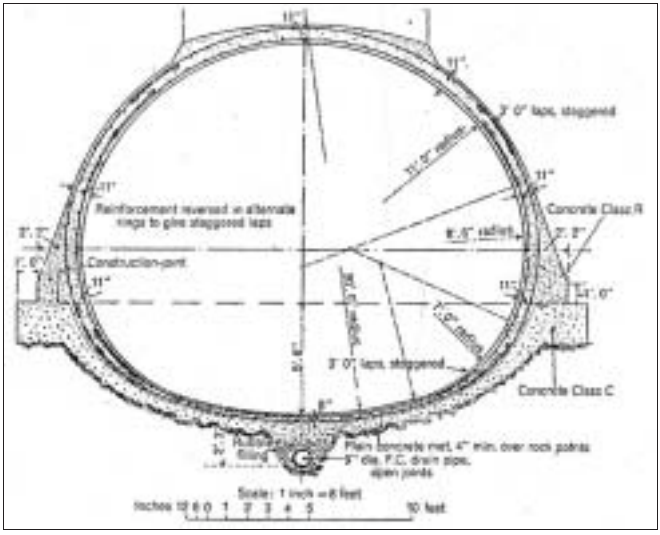
The southernmost dam of the Galloway scheme, over the Dee, is generally similar in construction to those at Kendoon, Carsfad and Earlstoun. It is a combined concrete arch and gravity dam 977 ft long of which the arched portion is 146 ft radius, 70 ft high and 290 ft long. The gravity section lies to the east of the arch and seals what is believed to be the former channel of the river. To the east of this are flood gates, each 25 ft wide and 31 ft high, and the spillway channel. A long, winding, fish ladder is provided with 29 steps, each with a rise of a little more than 2 ft, and three resting pools.

Tongland Dam
2006



Roland Paxton

The water is drawn off from Tongland Reservoir to the power station though an aqueduct tunnel 3335 ft long, one of the most interesting features being its shape. It is a flattened circle so proportioned as to produce, under the



Tongland
Aqueduct Tunnel
[20]

varying internal pressure, an approximately uniform circumferential stress in the steel reinforcement not exceeding 12 000 lb sq in.

The dam and its associated works including the power station were completed in 1934. The consulting engineers were Sir Alexander Gibb & Partners and the main contractor was John Howard & Co. Ltd. [19, 20]

Scottish Power's Galloway Hydros Visitor Centre at the Power Station, providing information on the scheme and guided tours, is open in the summer and well worth a visit.

11. Glenlochar Barrage

HEW 1457/08
NX 7319 6458

In order to increase the very limited capacity of the Loch Ken regulating reservoir, the water level of Loch Ken was raised approximately 6 ft by the construction of a barrage of six lifting gates at Glenlochar. They are of the fully-balanced free-roller type of 45 ft clear span, three gates being 10 ft deep and the other three 9 ft. They can be operated either manually, by electric push-button control from the bridge, or by a remote control from the Tongland power station. A fish pass is provided in the centre of the structure. The barrage was completed in 1934. The consulting engineers were Sir Alexander Gibb

Glenlochar Barrage and Bridge in ca.1934

Altigraph Ltd, Scottish Power Generation Ltd

& Partners and the main contractor was John Howard & Co. Ltd. The control gates were made by Glenfield & Kennedy Ltd, Kilmarnock. [19, 20]

12. Glenlee Tunnel and Power Station

HEW 1457/09
NX 6028 8026

Glenlee Tunnel connects Clatteringshaws reservoir to Glenlee power station. Water is not drawn off from the reservoir at the dam, but at the eastern side about $1\frac{1}{2}$ miles north of it. The tunnel has a total length of 3.6 miles and a flattened circle cross-section of 11 ft equivalent diameter.

It is concrete lined throughout and over the greater part of its length is constructed on a gradient of 1 in 350, the last 3600 ft being on a gradient of 1 in 100. At about its midpoint the tunnel passes under the Craigshinnie Burn, which is intercepted and its water led into the tunnel through one of the vertical driving shafts adapted for the purpose. There is a surge shaft on the tunnel close to the downstream portal at Glenlee.

A single steel pipe of maximum diameter 9 ft 6 in. and 1600 ft long joins the tunnel portal to the power station. The main contractor for the tunnel construction was A. M. Carmichael and for the steel pipeline, Sir Wm. Arrol & Co. Ltd.

Glenlee Power Station

Roland Paxton

Since the 1970s the whole scheme has been controlled from Glenlee Power Station. [19, 20]

13. Clatteringshaws Dam

HEW 1457/01
NX 5452 7536

This dam is of the concrete gravity type with a maximum height 78 ft from river bed to the crest footway. It is 1470 ft long and slightly curved in plan. The footway is carried on a series of arches and the central spillway has an effective length of 350 ft. It is easily viewed from the adjacent A712 public road.

The dam occupies almost an ideal site for a work of this kind, being founded on sound granite, practically free from significant fissures, at a shallow depth.

The reservoir formed above the dam is 1.6 square miles in extent. The draw-off tower for the tunnel aqueduct to the Glenlee power station is located about $1\frac{1}{2}$ miles from the dam at the east side of the reservoir.

The dam was completed in 1934 and the reservoir formed by 1938. The consulting engineer was Sir Alexander Gibb & Partners and the main contractor was Shanks McEwan Ltd. [19, 20]

Beside the A712, near the dam is High or Clatteringshaws Bridge over the Dee built by John McCraken for the Commissioners of Supply of the Stewartry in 1789 on the New Galloway to Newton Stewart road, bypassing a bridge of ca.1703 about a mile upstream, the site of which is now in the reservoir. This bridge built with two 40 ft arch spans

Altigraph Ltd, Scottish Power Generation Ltd

Clatteringshaws Dam and bypassed High Bridge in ca.1934

and 18 ft wide overall, has squared granite in the arch rings and pier and affords a good example of contemporary local practice on a main road. It is now closed and without parapets, but worthy of preservation.

14. Earlstoun Dam

HEW 1457/06
NX 6142 8240

Advantage was taken of the existence of a rocky gorge in the bed of the Dee at Earlstoun to construct an arch dam very similar to that at Carsfad. The dam provides a gross head of 69 ft for the Earlstoun Power Station. A concrete gravity section joins to the south end of the arched section of the dam, and this contains the spillway. Two large flood gates assist the discharge of water.

The dam was completed in 1937. The consulting engineer was Alexander Gibb & Partners and the main contractor was A. M. Carmichael Ltd.

Immediately downstream of the dam is Kirkcudbrightshire County's Allen Gibbon Bridge built in reinforced concrete in ca.1926 which is of a type that belies its appearance. The main arch span is flanked by approaches, the one on the east appearing as arches from its façades when its spans are in fact straight 'T' beams. [19, 20]

15. Carsfad Dam

HEW 1457/03
NX 6065 8566

This dam is of an unusual shape, being curved in plan to three different radii and of varying heights and cross-sections. It is of concrete and of combined arch and gravity form, with a maximum height of 70 ft from the river bed to the footway on the dam top. It was completed in 1937.

The dam is located on the Water of Ken about two miles below the Kendoon Power Station and provides a reservoir whose top level is one foot below the tail-race level at Kendoon. Flood waters demanded a spillway extending the full width of the central arched portion of the dam plus the gravity section on the west bank, making a total spillway length of 736 ft. The total crest length of the dam is 1650 ft.

A fish pass of the ladder type is provided comprising 35 steps divided by resting pools into four flights.

The consulting engineer for the dam was Sir Alexander Gibb & Partners and the main contractor was A. M. Carmichael Ltd. [19, 20]

16. Kendoon Power Station

HEW 1479
NX 6053 8779

This station is about one mile downstream from Ken Dam, and just south of the junction of the Blackwater Burn tributary. It contains two 10.5 MW turbines of the vertical-shaft single-floor type. The natural gradient of the two mile stretch of river below the power station has been utilised by the construction of Carsfad Dam, which ponds the water back to one foot below the level of the concrete sill controlling the tail-race level at Kendoon.

Carsfad power station operates in conjunction with Kendoon where greater storage is available. The entrance to the power station intake at Kendoon is protected by a series of vertical screens to safeguard fish from being trapped as they enter the fish pass. A similar arrangement exists at Carsfad. The consulting engineer was Sir Alexander Gibb & Partners and the main contractor, A. M. Carmichael Ltd. [19, 20]

17. Ken Dam

HEW 1457/05
NX 6131 8931

The Water of Deugh joins the Water of Ken about $4\frac{1}{2}$ miles below the village of Carsphairn. A short distance upstream of this confluence, the two streams pass through narrow wooded gorges where the Deugh and Ken dams are located.

Ken Dam is similar to Deugh, but with its spillway 4 in. higher. Both are partly concrete arch design and partly gravity section with the purpose of creating head and providing daily storage. Its arched section has a maximum height of 81 ft from the river bed to the crest footway and has a developed length of 220 ft, a radius of 165 ft and a 4 to 1 batter. The surface rock on the south bank was of poor quality resulting in the spillway channel being concrete-lined throughout. After dropping sharply to the river the spillway terminates in a concrete bucket (or energy dissipater) designed to destroy the kinetic energy of the flood water and prevent erosion of the river bed.

The dam was completed in 1937. The consulting engineer was Sir Alexander Gibb & Partners and the main contractor, Sir Robert McAlpine & Sons Ltd. [19, 20]

18. Deuch Dam

HEW 1457/04
NX 6057 9061

Less than a mile west of Ken Dam is Deuch Dam. Its arched section has a maximum height of 85 ft from the river bed to the crest footway and has a developed length of 356 ft, a radius of 220 ft and a 3 to 1 batter. The total length, including the gravity section containing the spillway, is 780 ft. This dam was also completed in 1937 with the same engineer and contractor as Ken Dam. [19, 20]

19. Loch Doon Dam

HEW 1457/07
NS 4772 0143

Loch Doon Dam provides the main seasonal storage for the upper three power stations on the Dee. Its original level was raised 27 ft by the construction of the dam across its natural outlet at the northern end.

The total length of the dam is 980 ft, the main central portion consisting of a mass concrete structure of the gravity type, slightly curved in plan. There is a 16 ft wide roadway along the crest. Flood water is dealt with by the 110 ft wide spillway assisted by a group of three siphons on the north flank. An interesting feature of the dam is the fish pass, which rises spirally inside a circular concrete tower within the reservoir.

This dam was also completed in 1937. The consulting engineer was Sir Alexander Gibb & Partners and the main contractor, Sir Robert McAlpine & Sons Ltd. [19, 20]

20. Ken Bridge, New Galloway

HEW 0207
NX 6404 7835

This bridge, now carrying the A712 over the Ken, was one of Rennie's last bridges, built from 1820–24. It has five segmental arches increasing in span towards the central one of 90 ft, the whole elevation having an elegantly curved parapet line. The contractor was Kenneth Mathieson and the cost £10 960. Numerous marks identifying the work of particular masons can be conveniently seen from the Ken Bridge Hotel garden. The bridge's plain lines in substantially-built coursed grey granite perhaps reflect something of Rennie's character of 'severe truthfulness'.

A bridge near the site, built in 1795–97, was destroyed by floods in 1806. Both Telford and Rennie made proposals to the Commissioners of Supply for its replacement in

Ken Bridge

1811–12. Telford's proposal was for a 150 ft span cast-iron arch of the Bonar Bridge type estimated to cost £6715. This was turned down for the rather specious reasons of its vertical 'curvature' and supposed greater cost than a stone bridge. In the event, the stone bridge was to cost much more than the iron arch although its eventual total waterway was much greater.

A three-arch masonry design of John Hall, who had been inspector of works at Newton Stewart Bridge, with spans of 65 ft and 70 ft, was accepted with Telford's approval for the parliamentary financial contribution. The contractor was John Simpson and work started in 1814, but on 25 August 1815 (two months after Simpson's death) the partially completed bridge was destroyed by a flood. The contractor was held responsible and his surety Loxdale was eventually required to pay compensation of £2250. [9]

21. Loch Ken Viaduct, Parton

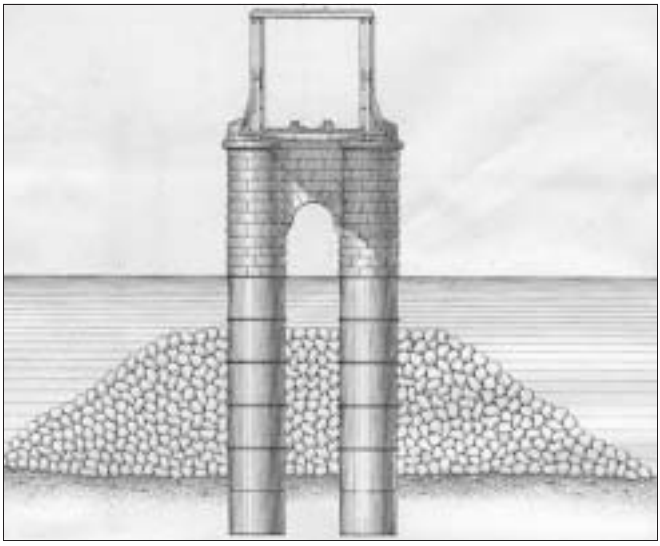
HEW 1770
NX 6839 7034

This viaduct, originally carrying the Portpatrick Railway over Loch Ken, one of the earliest surviving examples of its type, is now in private ownership connecting two farms. It has three then state-of-the-art wrought iron bowstring lattice girder spans, each of 138 ft and $17\frac{1}{2}$ ft maximum height and is built on a curve of 880 yd radius. The bowstring rather than a parallel top and bottom member girder was chosen, in the view of its engineer, because of the efficiency of its uniform cross-section for top and bottom members, pairs of channels 8 in. × 4 in. × 4 in. × $\frac{1}{2}$ in., and its simplicity of construction. The masonry of the piers rests on cast-iron

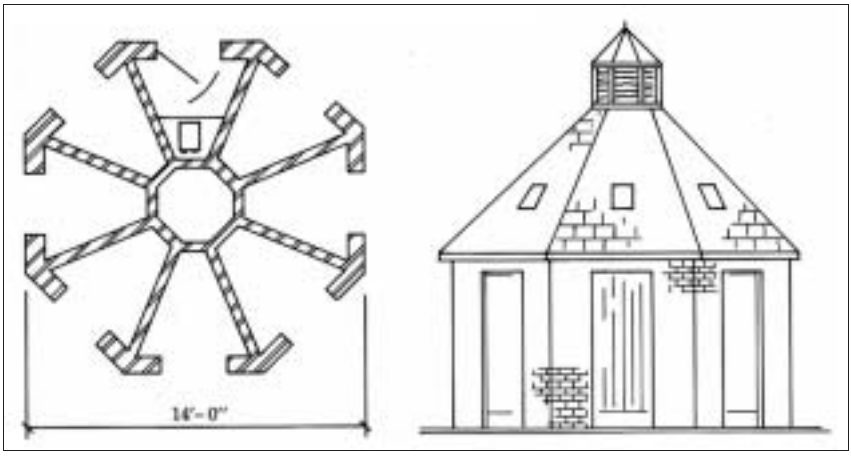
Blyth & Blyth

Loch Ken Viaduct

tubes up to 42 ft deep which were sunk to their final depth by a novel use of screw-piles. The viaduct was designed by B. & E. Blyth, consulting engineers and built by Thomas Nelson & Co., Carlisle in 1859–60 at a cost of about £13 000.



Loch Ken Viaduct cross-section [21]



Parton Privy [22]

A fascinating example of late-Victorian sanitary engineering exists nearby in Parton opposite the village hall. It is an octagonal eight-privy building of 1901 in red brick with a Cumberland slate roof which served eight cottages for many years. It was known as the 'Houses of Parliament' and is now conserved with one privy available for inspection only. [21, 22]

22. Glenlochar Bridge

NX 7320 6451

This substantial bridge carries the B795 Laurieston road over the Dee north-west of Castle Douglas. It was built from 1797–99 and has six masonry arches each of $39\frac{1}{2}$ ft span, and a width between parapets of $17\frac{1}{2}$ ft. The masonry is grey granite with dressed arch stones and random rubble parapets with dressed copes.

The cutwaters are rounded with buttresses above which are blind circular medallions in the spandrels. The bridge was built by Samuel McKean and John McCraken was consulted. [23] (See right-hand side of figure 1-11.)

23. Glenlair Bridge

HEW 1572
NX 7610 7218

This whinstone arch bridge of 45 ft span and 16 ft overall width crossing the Urr is in the tradition of Telford's Highland bridges.

Ken McCrae

Glenlair Bridge

Although not of any special engineering merit, the bridge is of interest in being commissioned by physicist James Clerk Maxwell of nearby Glenlair House from his 23-year-old cousin William Dyce Cay, who was destined to have an outstanding career in maritime engineering in north-east Scotland.

It is fascinating to read of Cay's recollection, during a walk from Glenlair to Parton, of Maxwell, 'giving one explanation after another to explain by illustration the principle of virtual velocities . . . before I got to the bottom of one example he had rushed off to another.' When at the University of Edinburgh some five years earlier Cay had won the highest mathematical prize, the Straiton Gold Medal, thanks, he acknowledged, to some excellent tuition from his cousin!

The bridge was built in 1861–62 whilst Cay was an assistant in the office of B. & E. Blyth working on the Castle Douglas to Portpatrick Railway. [24]

24. Old Bridge of Dee or Granyford Bridge, Kelton

HEW 0908
NX 7343 5995

This bridge, about two miles south-west of Castle Douglas, was built over the Dee from 1737–40 on the road from Carlisle to Portpatrick and was made use of by the military road in 1763. It is 11 ft wide between parapet faces and has four masonry arches each of 41 ft span. The rubble stonework is whinstone and granite. The cutwaters are pointed and the parapets corbelled at road level with squared granite copes.

Details of road construction in 1763 and toll road improvements following an act of 1797 on roads in the locality, including a specification of 1798 for a road of 16 ft wide middle cross-section with a 12 in. depth of gravel and drainage details, have been published. The bridge was bypassed by Threave Bridge in 1825, and the grouting of joints and spandrel repairs were carried out in 1989.

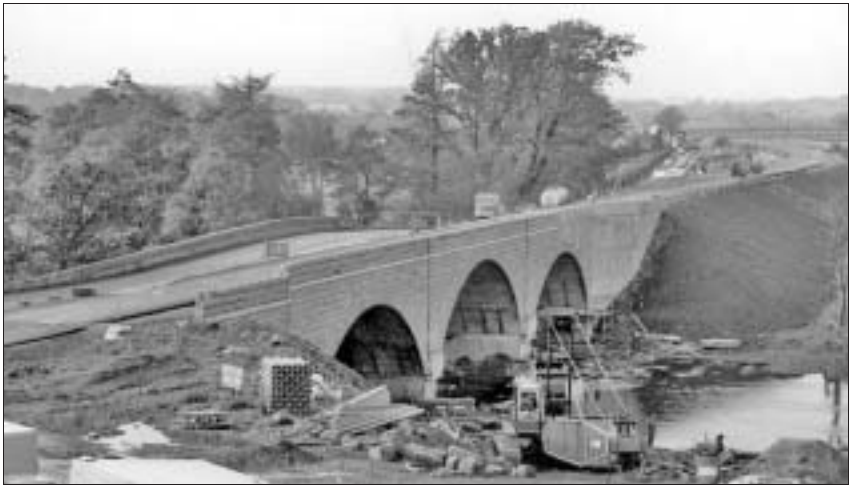
In 1785, just before the military roads were handed over to the county authorities, there were 106 miles of such roads and 73 bridges in Dumfries and Galloway. [25]

25. Threave Bridge, Castle Douglas

HEW 0909
NX 7373 6033

Threave Bridge, also over the Dee, is on the A75 about two miles south-west of Castle Douglas. It was built for the turnpike road trustees from 1823–25 when the Carlisle to Portpatrick road was realigned. The bridge has three masonry arches in grey granite of which the outer spans are 54 ft and the centre span is $58\frac{1}{2}$ ft. Its width was 18 ft between parapet faces. The bridge was originally designed by Kenneth Mathieson, but reviewed and modified by Edinburgh civil engineer James Jardine. The contractor was John McCraken.

In 1986 the bridge was doubled in width, requiring the taking down and rebuilding of the downstream face. The arches were strengthened at the same time and a reinforced concrete deck provided on top of the hollow spandrel walls. The new arch width was also constructed in this material but this is masked by the granite facing except at the unfinished far side in the view. The engineers were W. A. Fairhurst & Partners and the contractor, Barr Ltd,



J. Caughlin for Barr Ltd

Threave Bridge Reconstruction

and their reconstruction won a Saltire Society Civil Engineering Construction Award in 1988.

The reconstruction required a flatter gradient for modern traffic. The original elevation with its rise from the sides to the centre, which dictated the arch dimensions, can be seen at the rear of the view. [26]

26. Southerness Lighthouse

HEW 2430
NX 9774 5428

In 1748 Dumfries Council was concerned for the safety of shipping bound for the estuary of the Nith and the town. Peter Milligan, a local mason, was instructed to build a 'beaken' of stone $14\frac{1}{2}$ ft square, $2\frac{1}{2}$ ft thick and 30 ft high at Southerness point, which he did in 1749. By 1795 it had been heightened but was without lights.

The lighthouse was taken over by the Nith Navigation Commission in 1811 and in 1815 a reflector light was operational. Robert Stevenson almost certainly had an involvement with this improvement.

In 1837 Stevenson's assistant James Slight reported on improving the lighthouse, pointing out that it was visible for up to nine miles but only within a limited radius towards the Irish Sea. It then had a facetted glass reflector of 4 ft diameter of the type dating from 1787–1804 and the 20 in. silvered copper parabolic reflector with Argand lamp of 1815.

Roland Paxton

Southernness Lighthouse

In 1843–44 the tower was extended about 18 ft to its present height under the supervision of Walter Newall and two new reflector lights were installed in what is the present lightroom with an arc now exceeding 200°.

The light was extinguished in 1867 as coastal trade declined, but restored in 1894 at an expense of £250 with a lantern by James Milne & Sons, Edinburgh, the frame of which is displayed within the ruins of a limekiln nearby. It ceased to operate in ca.1936. [27]

27. Dumfries Suspension Bridge

HEW 1769
NX 9725 7570

This bridge at Whitesands over the Nith, originally providing pedestrian access to and from the mills on the west bank, was designed by John Willet and erected in 1875 by J. Abernethy & Co., Aberdeen, at a cost of about £1500. The span is 200 ft and the chain-link cables are in pairs, each wrought iron eye-bar link being about 5 ft between the suspending rods. In cross-section the individual links are of the Telford 1820s Menai Bridge genre but of $4 \times \frac{3}{4}$ in. cross-section.

Dumfries Suspension Bridge

Roland Paxton

The towers each consist of a pair of plain circular cast-iron columns, 17 ft high, bridged at their tops by a heavy ornamental entablature bearing the cable saddles. The columns sit on freestone masonry piers about 10 ft tall. The columns are not braced except for the capping beam and the ornamental arch in the view. The deck is stiffened by lattice girders forming the parapets.

The bridge was described at its opening as 'an airy graceful thing of beauty that might have been conjured into existence by the wand of an eastern magician'. It was refurbished by Whatlings Ltd in 1983 under a contract let by consulting engineers W. A. Fairhurst & Partners. [28]

28. River Nith Cauld, Dumfries

HEW 1839
NX 9695 7598

This weir was built in 1705 to divert water from the Nith, which was causing erosion of the area known as Whitesands on the east bank. In 1707 Matthew Frew built a mill on the west bank and made use of the diverted water.

The weir was often breached by Nith flood water between 1730 and the 1760s. In 1760 Smeaton was

Roland Paxton

River Nith Cauld

consulted about the state of the river on navigation and erosion prevention issues. In 1768 Smeaton reported on the condition of the weir. The mill was renewed in 1769 at a cost of £990 by East Linton millwright Andrew Meikle and the weir refurbished as necessary, essentially as it is now.

In the early 20th century the lade supplied water to power a low-head turbine driving a 100 kW DC generator in the mill which supplied electricity to the Troquair area of Maxwellton. This was abandoned in 1922 and the building is now Dumfries Museum's Burns Centre. [29, 30]

29. Devorgilla Bridge, Dumfries

HEW 1838
NX 9689 7605

This historic bridge over the Nith built for Devorgilla, mother of John Baliol, one of the oldest in Scotland, originally dated from the mid 15th century, a date of ca.1431 has been mooted. Its width between parapets is 14 ft. The bridge originally had nine masonry arches of irregular spans and rises.

In 1619 the five arches on the west side were carried away in a flood, but rebuilt within a year; a tremendous

Roland Paxton

Devorgilla Bridge

undertaking at a time when it was more usual to build one span each year and reuse the centring. In 1725 Gilbert Smith rebuilt the parapets.

In 1828 the three arches at the eastern end of the bridge were removed. It is now used as a public footbridge. Very little of the bridge now dates from before 1620. [31]

30. Buccleuch Street Bridge, Dumfries

HEW 2431
NX 9680 7613

This five-span masonry bridge over the Nith (visible in the figure in 1-29) was designed by Thomas Boyd and built between 1791 and 1794 by William Stewart at a cost of £4855 including approaches. The outer arches have spans of 43 ft, the inner arches 50 ft and the centre arch 58 ft.

In 1893 the bridge was widened by corbelling of the piers to support riveted steel lattice girders, with ornate cast-iron facings, carrying joists and jack arches spanning from the girders to the masonry spandrels to give a width between parapets of 46 ft. This work was executed by Sir William Arrol & Co. Ltd to designs by James Barbour.

The bridge is now not what it seems as, in 1935, strengthening in reinforced concrete involving relieving arches and a new deck slab supported on piers, created an open spandrel structure masked by the original masonry facing.

In 1984–85 the bridge underwent further strengthening, widening and replacement of parapets in a manner which maintained the character of the original girders. The consulting engineers were Babtie, Shaw & Morton and

the contractors Norwest Holst who used R. Watson & Co. as steelwork fabricators. [32]

31. Arrol-Johnson Works, Heathhall, Dumfries

HEW 2432
NX 9895 7907

The Arrol-Johnson company was one of the early builders of motor cars in the United Kingdom and reputed to be the first in Scotland. A completely new factory was built for the company on the outskirts of Dumfries by S. Stevenson & Co. of Glasgow in 1912–13. The main building was of reinforced concrete using the Kahn system of the Trussed Steel Co. It was originally L-shaped in plan and 42 000 sq ft in area. In addition there were buildings housing a foundry, gas supply and electric power plant, together with staff houses.

A famous product of this works in the 1930s was Sir Malcolm Campbell's *Bluebird* car, which for a time held the world land speed record.

The main building suffered from spalling and deterioration of the concrete and was completely refurbished in the 1980s. For many years the building was owned by the Uniroyal Company and it now forms part of the Gates Rubber Company's works. [33]

Arrol-Johnson Works

Glasgow, Dumfries & Carlisle Railway

HEW 2433

This strategic West of Scotland railway, built in competition with the Caledonian Railway, obtained its parliamentary act in 1846. The company utilised the Caledonian Railway line from Gretna to Carlisle. Construction began in 1847 and the through connection to Glasgow was achieved against considerable financial and engineering difficulties on 28 October 1850 following the completion of Drumlanrig tunnel.

The line then became part of the newly formed Glasgow & South Western Railway. John Miller was the company's engineer until August 1849 after which, as an economy measure, he acted in a consulting capacity, the superintendence of the remaining work devolving on resident engineers James Deas and Hugh McLure. [34]

32. Dumfries Railway Station

HEW 2433/01
NX 9765 7647

The original station of 1848, planned by Miller to the south of the present buildings, no longer exists. The west block fronting Station Square was built in 1863. It is gabled with two-storeys and an attic and has long flanking wings with decorative timber eaves and steel-framed glazed platform awning on cast-iron columns. The station was greatly extended in 1875–76 with the erection of the

Roland Paxton

Dumfries Railway Station

Carron Viaduct [photograph ca.1890]

booking office and other buildings on the east side. The engineer was James Bell. The large Station Hotel (at left in the view) was built in 1896. [35]

33. Carron Viaduct

HEW 2433/02
NS 8805 0112

This spectacular viaduct over the Carron Water, 117 ft high with slender piers and six semicircular arch spans of 50 ft, was also designed by Miller. It probably formed part of the Drumlanrig contract for £144 953 awarded to Brown & Oliver of Walbottle in 1847, which was taken over with mutual agreement by Thomas Campbell in 1848. In December 1846 Miller tried unsuccessfully to get Ross & Mitchell to do this contract at the same figure as Brown & Oliver. The resident engineer was James Deas, later engineer to the Clyde Navigation.

Other notable viaducts in the vicinity, also designed by Miller, include **Cample** (NX 8980 9410), **Carronhill** (NX 8770 9830), **Enterkin** (NS 8580 0430) 111 ft high with four arches of similar construction and **Crawick Viaduct** (NS 7750 1100). [34]

34. Drumlanrig Tunnel

HEW 2433/03
NS 8688 0201

The 1400 yd long tunnel, one of the heaviest works and the 'key to the whole line', was required to be on an alternative route to the Nith valley to meet the requirements of the

Ken McCrae

Enterkinfoot retaining wall

Duke of Buccleugh that the railway should be at a distance from Drumlanrig Castle and Park.

The tunnel proved to be an engineering challenge beyond the skills of Brown & Oliver who, in 1848, found it expedient to enter into an arrangement with Thomas Campbell, an expert tunnelling contractor, who successfully completed the contract for the Drumlanrig section of the line by October 1850. The number of men at work on this section in 1847 was 600. Miller was the engineer and Deas the resident engineer. [34]

35. Enterkinfoot Retaining Wall

HEW 2433/04
NS 8519 0506

This massive wall adjoining the A76(T) road was built in ca.1848 to accommodate the railway high above on the steep slope down to the Nith which flows immediately below the road. The track is supported on stone backfill behind and near the top of the wall.

This railway, built in competition with the Caledonian Railway line over Beattock summit, was opened in 1850. Miller was the engineer. The resident engineer and contractor were probably the same as for the tunnel. [34]

36. Auldgirth Bridge

HEW 2434
NX 9116 8635

A substantial three-span masonry arch bridge constructed over the Nith about seven miles north-west of Dumfries in 1782. The spans are each 56 ft and the width between

Roland Paxton

Auldgirth Bridge

parapets is 25 ft 8 in. The bridge carried the A76 road until it was bypassed in 1979.

The bridge, now used as a cycle path, is notable as a design of David Henderson, Edinburgh architect and bridge builder. Alexander Stevens had, in 1779, advised taking down and replacing the bridge with two arches of 80 ft span. Henderson was commissioned in ca.1780 to report on the then unfinished bridge with a fractured pier begun by William Morton of Old Cumnock in 1773. Morton's work was demolished and a well-known local bridge builder, William Stewart, contracted for the bridge to Henderson's design which was completed in November 1782 at a cost of £1486.

Henderson produced 'a design of original architecture, three equal segmental arches framed over the cutwaters with pairs of thick ashlar pilasters which at parapet level carry a cornice running round the base of a refuge which is covered by a semi-dome giving shelter from rain for travellers on foot'. (Ruddock).

It is said that the father of Thomas Carlisle worked on the bridge's construction as a stonemason. [36, 37]

37. Creel Bridge, Drumlanrig Estate (Private)

HEW 2435
NS 8556 0054

This slender 3 ft wide estate footbridge, now ruinous, spans the Nith about 25 ft above the water. It is one of very few surviving structures of this genre developed by

Creel Bridge
[postcard 1907]

Robert Stevenson and others from the 1820s. The main span is about 42 ft and the side span 24 ft.

The iron deck stringer beams originally derived support from $\frac{3}{4}$ in. diameter tension rods beneath, anchored to the approach stringers but, as these rods have become detached from their deck spacers, the stringer beams now solely support the deck. The bridge is almost certainly that shown on the 1856 Ordnance Survey map and may date from the 1830s. The iron stringers and supports may have originally been timber.

The bridge is now unsafe and closed.

38. Knockenjig Waste Treatment Plant, Kirkconnel

HEW 2436
NS 7493 1153

The first purpose-built combined sewage and refuse plant to be built in Scotland. It was opened by the Secretary of State in 1953. The sewage treatment plant comprises grit channels, screens and settling tanks, biological filters and a humus tank.

The refuse plant, now no longer in use, comprised a reception hopper, trummel screen for the removal of ash,

stones etc., magnetic separator for the extraction of ferrous metal, picking belt for the separation of non-compostables and *BJD* hammer mill for chopping turnips.

For composting, material is prepared in layers of straw, pulverised refuse and sewage sludge. After a composting period of 13 weeks, the material is screened and bagged for sale under the trade name Eradite.

The plant was designed by J. C. Wylie to deal with sewage from a population of 5000 and refuse from a population of 8000. The contractor for construction of the plant was Dumfries County Council. [38]

39. Raehills Three-Way Footbridge, St. Ann's (Private)

HEW 2437
NY 0688 9351

An unusual late-19th century creation for the Hope Johnson family of Raehills about 100 yards upstream from the A701 road bridge. The bridge formed part of a circular garden walk known as Wallace Loup along each side of the Kinnel Water. Its arms comprise 10 in. deep timber beams 42 ft and 46 ft long, with tension rods beneath, similar to Creel Bridge but deeper, spanning to a pagoda on a central pier of masonry in the river.

The bridge is owned by the Annandale Estates.

Raehills Three-way Footbridge

Glasgow & Carlisle Road (General and Dumfriesshire)

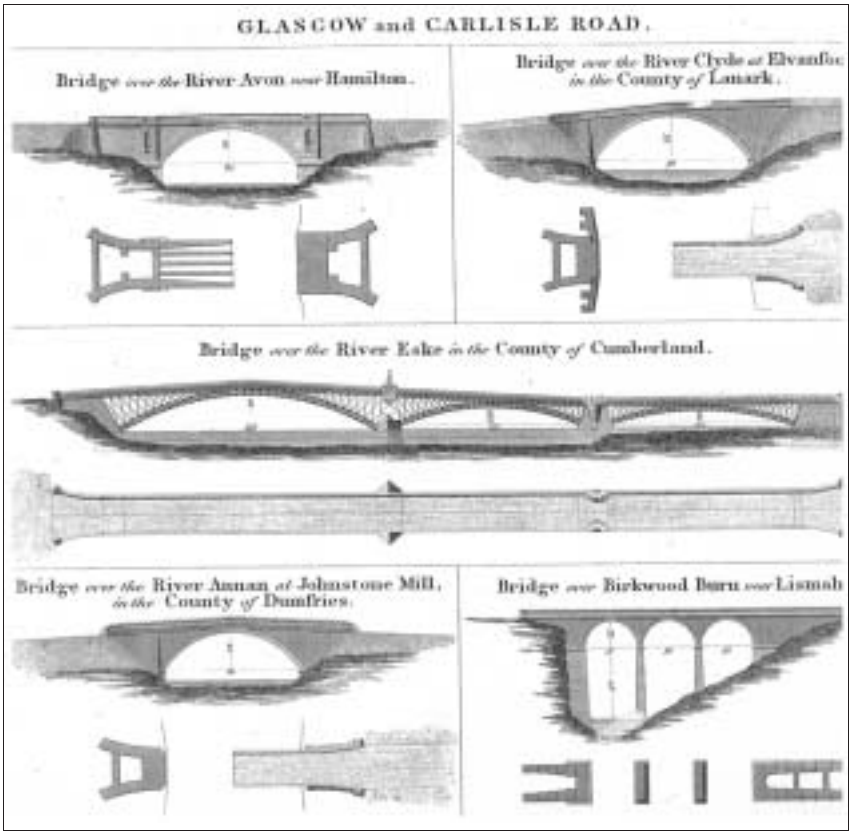
HEW 2438

This strategic mail road, which in 1814 under the turnpike trusts had 'become nearly impassable', was surveyed by Telford's chief assistant W. A. Provis in 1814–15, and improvements planned; which were implemented by 1825. It was the Georgian equivalent of a modern motorway, reducing the mileage of the route from $102\frac{1}{2}$ to about 93 miles, of which about 69 miles had to be newly made. The longitudinal profile ranged from near sea level to nearly 1000 feet at Beattock summit. A ruling gradient of not steeper than 1 in 30 was generally adopted, involving extensive cut and fill and 15 large bridges.

The general specification, no doubt varied somewhat in its implementation, called for the main carriageway to be 18 ft wide, to allow two mail coaches to pass in safety, with a crossfall of 4 in. Its construction comprised Telford's traditional hand-pitched bottom course of 7 in. high stones surmounted with a 7 in. layer of broken stones passing a $2\frac{1}{2}$ in. diameter ring and had a 1 in 30 crossfall from the centre line. The roadway had an 8 ft extension on each side comprising a gravel layer for use by horse and foot passengers, beyond which were the all important side drains. The whole metalled width was compacted with a heavy iron roller.

Eight toll houses, spaced more or less evenly along the road length, existed at Kingsmuir, Gretna, Dinwoodie, Beattock, Douglas Mill, Abington, Lesmahagow and Hamilton. Only three now survive: Gretna, later well known as a runaway marriage house; Dinwoodie, about eight miles south of Beattock; and Hamilton. The fine inn and stabling, designed by Telford at Beattock, still exists.

Of the bridges, the most unusual, just south of the Border between Scotland and England, was the three-span cast-iron arch bridge of ca.1820 over the Esk, adjoining what became the *Metal Bridge Inn*. It had a main span of 150 ft and two spans of 105 ft and was made to Telford's standard prefabricated lattice spandrel design by Hazledine in Denbighshire. The northern span was almost certainly added during construction



Glasgow and Carlisle Road Bridges [40]

when the need for additional flood accommodation was realised, hence the asymmetrical elevation. A parapet centrepiece is preserved at Tully House Museum, Carlisle. The bridge was replaced by a reinforced concrete structure in 1915.

The Act provided for not less than ten broken stone depots per mile. A single man maintained a length of one to five miles, depending on usage. In winter, men were employed in keeping the road clear of mud and water. In summer they removed loose surface stones, filled pot-holes, cleared drains and repaired retaining walls.

The original single carriageway A74 road was replaced in the 1960s with a dual carriageway and upgraded to the present motorway from 1990–94. [39–41]

Top: Beattock bridges [postcard J. Weir ca.1930]

40. Beattock Bridge

HEW 2438/01
NT 0779 0277

This bridge, still in service for local traffic, crosses the Evan Water in a single 40 ft span. It was widened on one side in 1955, at which time the original roundel seen in the view on top of the east parapet was built into the wall of the approach. The bridge was built by John MacDonald in

Beattock Bridge – relocated roundel

Roland Paxton

1819 to Telford's design, bypassing the earlier bridge (1719). [42]

41. Beattock Inn

HEW 2438/02
NT 0775 0283

This elegant purpose-built facility for the use and convenience of travellers, formerly known as the Beattock Bridge Inn, was the only one of its kind on the new road. It was designed by Telford, also built by MacDonald, and with the stabling formed a state-of-the-art staging post at Beattock operational from ca.1825. The entry to the stable yard bears the inscription over the arch 'Licensed to let post horses'. Being directly on the line of the road it saved the two miles of travel to and from the previous staging post in Moffat.

Externally the building is substantially in its original state with Tuscan columns and entablature at the doorway and, internally, although greatly altered, it is still possible to gain an impression of its spacious utility. Its two chimney stacks are centrally pierced with a semi-circular arch, perhaps a more appropriate signature than the quatrefoil at Dinwoodie Toll House.

Following the opening of the Caledonian and North British Railways in the late 1840s, use of the staging post declined and eventually the building served as a farmhouse and, more recently, as a restaurant. Its future is presently under review.

Beattock Inn

Roland Paxton

Beattock Inn doorway

Roland Paxton

In a road building context Moffat is also of interest in having, in the town church yard, the grave of J. L. McAdam who lived nearby at Dumcrieff, where one of his stone road rollers still survives in the grounds.

42. Dinwoodie Toll House

HEW 2438/03
NY 1043 9015

Externally this ashlar masonry building is essentially in its as-built state and is the best surviving toll house on the road. It was built in 1822–23 by John MacDonald to Telford's standard design with a shallow pitched roof and broad eaves, somewhat austere, with little ornamentation except for a quatrefoil through the masonry of the chimney head illustrative of Telford's fondness for the

Dinwoodie Toll House

The late Norman Miller

Gothic style. The total cost of the toll house including land, fences, a stable, pig-sty and privy was £314 0s 11d.

The toll house ceased to operate as such after the passing of the Roads and Bridges (Scotland) Act 1878, and passed into private hands in which it is still. For many years it has been well maintained by the late Norman Miller and his wife Margaret. The widening and upgrading of the road into the dual carriageway A74 in the 1960s bypassed much of the original carriageway. This does, however, still exist from the toll house southwards as a local access road, from which one can still glean something of the road's former scale and character.

The house was up-listed to category A by the Secretary of State in 1988 on the initiative of the Institution's Panel for Historical Engineering Works. In 1995 when the adjacent A74(M) road works were being carried out, landscaping of the immediate surroundings of the building was undertaken. [43]

43. Dinwoodie Green Milestone

One of very few remaining original whin milestones against the wall of a farm building, adjoining the original road now used for local access, bearing a cast-iron plate with the legend: GLASGOW ← 65 CARLISLE $29\frac{1}{2}$ →.

Dinwoodie Green Milestone

Roland Paxton

44. Mein Water Bridge, Ecclefechan

HEW 2438/05
NY 2014 7427

A single-span masonry arch bridge of 51½ ft over the Mein Water built, according to an inscribed stone in the parapet, by 'Parks Masons Thomas Telford Engineer 1826', a local firm, for a little over £100 it is said. The width inside the parapets is about 18 ft.

Mein Water Bridge

This is a fine example of an original bridge. It is in the typical form of the Highland bridges with tapering

Roland Paxton

pilasters adjoining the springings and curved wing walls, but is generally of better quality being in coursed squared stone with a well executed arch ring 27 in. at the crown and 30 in. at the springings.

The bridge was bypassed by the M74 but is still used for local access.

45. Hoddom Bridge, Ecclefechan

HEW 2439
NY 1636 7271

A substantial three-span masonry arch bridge over the Annan on the B725 road about three miles west of Ecclefechan. The outer arch spans are 46 ft and the centre arch 65 ft. The masonry work is diagonally droved with recessed arch rings. The cutwaters are pointed.

The bridge, a good example of its type, was built in 1762–64 by Alexander Lawrie, a stonemason from Newton Stewart, to replace a boat ferry. Its purpose was presumably to improve inland communication from the port of Annan at the onset of the Industrial Revolution. There is a similar bridge some three miles downstream at Brydekirk which was proposed in 1778 and completed in 1800. [44]

46. Annan Bridge

NY 1910 6658

A handsome three-span masonry arch bridge on a gradient over the Annan, just west of Annan town centre, on the former Carlisle to Portpatrick road. It was built from 1824–27 in Locharbriggs freestone and has arches of 57 ft span. The roadway is 20 ft wide and the width now between parapets is $27\frac{1}{2}$ ft. The cantilevered footways, supported on iron brackets and pilasters above the cutwaters, were a later addition.

The bridge, a notable achievement of Robert Stevenson, is pleasingly ornamented with channelled arch rings, helmeted cutwaters and pilasters with battered faces at the abutments. During its construction a temporary timber bridge costing £500 was provided alongside to accommodate traffic. Stevenson's son Alan, destined to create the graceful Skerryvore Lighthouse, gained experience on the bridge's construction. Its completion in August 1826 was celebrated by the workmen drinking a gallon of whisky!

The original bridge on this site, which was in line with the High Street (the present one is off-set), was condemned

Roland Paxton

Annan Bridge

as being beyond repair in 1813 by Telford, who proposed one of his standard prefabricated cast-iron lattice spandrel bridges of 150 ft span of the basic Bonar type in ca.1822. This would probably have cost marginally less than a stone bridge, but the local trustees adopted Stevenson's design. The contractor was John Lowry and the bridge cost about £6000. [45–47]

47. Skippers Bridge, Langholm

NY 3706 8340

Skippers Bridge, built between 1693 and 1700, now carries the A7 road over the Esk just south of Langholm. It is a good example of a country masonry arch bridge of its time with spans of 18 ft 3 in., 44 ft 8 in. and 43 ft 2 in. The masonry is squared rubble with arch rings of squared stone. The cutwaters are pointed.

The bridge was widened on the upstream side in 1806 giving a width between parapets of 20 ft. In 1926 it was strengthened by haunching over the arches with reinforced concrete.

A mile to the south, just out of sight, is a private, probably mid-19th century, recently refurbished iron arch footbridge connecting with Broomholm Island.

48. Langholm Bridge

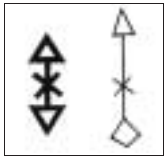
HEW 0324
NY 3630 8468

Langholm Bridge, now carrying the A79 road over the Esk, was built in ca.1775–78, probably jointly by local stonemasons Andrew Thomson and Robert Hotson. Its chief claim to fame is that Telford worked on the bridge as an apprentice mason to Thomson. Many people have searched its stonework for his mason mark. The mark on the east abutment recorded in 1996, which may or may not be Telford's, differs from the earliest known publication of his mark by Smiles in 1861 (left in figure) who does not give his source. Telford also carved the headstone of his father's grave in Westerkirk churchyard.

The bridge, typical for its date, has three segmental masonry arches, each of 41 ft span. The road is on an incline over the bridge and the rise–span ratios of the arches vary slightly to suit this. The masonry is uncoursed grey rubble with ashlar dressings, recessed arch rings and pointed cutwaters.

In 1880 the bridge was widened to 24 ft by John Hyslop with the addition of footways on each side carried on

Langholm Bridge – mason marks



Roland Paxton

Roland Paxton

John Telford's headstone

Roland Paxton

Duchess Bridge

cantilevered iron brackets. In 1995–96 widening and strengthening work complementing the original design attracted a Saltire Civil Engineering Awards design commendation. [48, 49]

49. Duchess Bridge, Langholm Lodge

HEW 1331
NY 3559 8523

A cast-iron arched footbridge forming part of a riverside walk over the Esk on the Buccleuch Estate at Langholm. It has a span of 104 ft, a rise of 6 ft, is 6 ft wide and is one of the finest early examples of its type. The ironwork was made in Workington, Cumbria and transported and, according to the Estate records, erected on site in Autumn 1813. The bridge is understood to have been designed by William Keir, Jnr.

A Telford influence in its graceful elevation is suggested by its cruciform rib form, radial orientation and handrailing. In detail the bridge exhibits the independent artistry of its designer. [50, 51]

50. Westerkirk Parish Library, Bentpath

HEW 2442
NY 3086 9007

This library has been included for its connection with Telford, the first President of the Institution of Civil Engineers, who when he died in 1834 left, when his

Roland Paxton

Westerkirk Library – unveiling of relocated Telford memorial

estate was settled, the then very considerable sum of £3000 to provide books for the people of Eskdale, at Langholm and Westerkirk.

The Westerkirk Parish library, said to be the oldest subscription library in continuous use in Scotland, is at Bentpath on the B709, behind the relocated Telford Memorial unveiled by Institution vice-president David Green (on the right) and William Cormie in August 1996.

The library, mainly books for general reading many of which in the 19th century were handsomely bound in leather, was started in the late 18th century by antimony miners in the nearby village of Jamestoun. The library then had various homes and, in 1862, at the initiative of local lairds, was moved to the present purpose-built building designed by W. G. Habershon, a London architect.

By 1990 the library and its several thousand books had become damp and neglected and, on the initiative of the Scottish Group of the Institution's Panel for Historical Engineering Works and interested local people, a committee was set up to refurbish the building and books. The sum of £100 000 was raised and the project, led by Mr Arthur Bell of Langholm, was brought to a successful conclusion with a public re-opening by the

Duke of Buccleugh on 4 July 1997. The library and its books may be seen by prior arrangement with Mrs Sanderson at the adjoining schoolhouse. The Langholm Library books are stored in the Town Hall. [52]

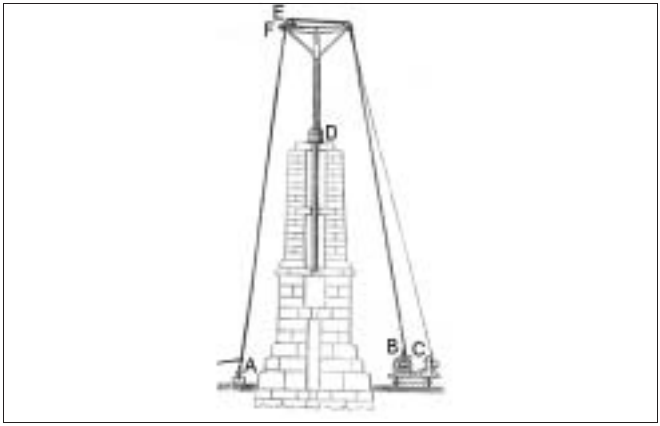
51. Malcolm Monument, Whita Hill

NY 3793 8468

This 100 ft high white sandstone masonry obelisk, which dominates the local landscape, was designed by Howe and erected in 1835 to the memory of Eskdale-born diplomatist and administrator Sir John Malcolm who had died two years earlier. It is situated on top of Whita Hill, a mile to the east of Langholm, and reached by footpath.

Two engineers helped in its creation, Telford and, indirectly, Robert Stevenson. Telford, who had known Sir John Malcolm well and had written a laudatory poem to him in 1831, was the monument's leading promoter, subscribing £50 out of the total of £396 by 188 well-wishers, but did not live to see it built.

The cost of erection of the obelisk by the ingenious Mr. T. Slack of Langholm was greatly reduced by the use of a modified version of the balance crane invented by Francis Watt under the direction of Stevenson for erecting Bell Rock Lighthouse (1810) and the Melville Column, St. Andrew Square, Edinburgh (1821). For this development, and innovative hanging scaffolding used for completing the pyramidal top of the monument, Slack was awarded the Gold Isis Medal of the Society of Arts. [53]



Malcolm Monument erection at Whita Hill [55]

Further reading

[1] STEVENSON, T. *Lighthouse Construction and Illumination*. Spon, London, 1881, 132.

[2] GRAHAM, A. Some old harbours in Wigtownshire. *Trans. Dumfries & Galloway Nat. Hist. & Archaeological Society*, **L1V**, 1979.

[3] CUNNINGHAM, R. R. *Portpatrick Through the Ages.* Author, Portpatrick, 1977, 4–13. Latest edition, Alba, Dumfries, 2004.

[4] DONNACHIE, I. *The Industrial Archaeology of Galloway*. David & Charles, Newton Abbot, 1971, 181–184.

[5] BARTON, J. The proposed tunnel between Scotland and Ireland. *Proc. Sect. 1. Railways. International Engineering Congress, Glasgow, 1901*, Clowes & Sons, 1902, 62–77.

[6] *Wigtonshire Free Press*, 12 August 1852 and 19 May 1853.

[7] *Edinburgh Evening Courant*, 21 Oct. 1816, 1, col. 2.

[8] CRESY, E. *Encyclopaedia of Civil Engineering*. Longman, London, 1856, 435.

[9] Kirkudbright Commissioners of Supply Minutes, at Ewart Library, Dumfries, 1811–1814. K1/1/6.

[10] Kirkcudbright. *The New Statistical Account of Scotland*, **IV**, Edinburgh, 292.

[11] DONNACHIE, I. *The Industrial Archaeology of Galloway*. David & Charles, Newton Abbot, 1971, 166–167.

[12] ANDERSON, A. The third rebuilding of Fleet Bridge, Gatehouse 1964–65. *Jnl. Instn. Municipal Engrs*, **96**, Sept. 1969, 264.

[13] TELFORD, T. *Life* . . . (ed. J. Rickman), Payne & Foss, London, 1838, 31–32, pl. 8.

[14] Kirkudbright Commissioners. *Op. cit.* K1/1/5.

[15] SMITH, REV. S. *General View of the Agriculture of Galloway.* Phillips, London, 1810, 324–327. Anr. edn. 1813.

[16] MAITLAND, C. A. S. *Commissioners of Supply for the Stewartry of Kirkcudbright.* 1933, 112.

[17] TELFORD, T. Bridge. *Edinburgh Encyclopaedia*. Edinburgh, 1830, **IV**, pt ii, 530–534, pl. LXXXVII, C. First published, 1812.

[18] *The Scots Magazine*, LXIX, Dec. 1807, 883, pl. (drawn by P. Nasmyth, son of Alexander).

[19] *The Galloway Water Power Scheme.* Reprinted from *The Engineer*, 12, 19 and 26 Oct. 1934, The Galloway Water Power Co. London, 3–28.

[20] *The Galloway Hydro-Electric Development*. Reprint of [3] papers presented to the Institution of Civil Engineers, 22 February, 1938?, The Galloway Water Power Co. by Hudson, W. and Hunter, J. K., Hawthorne, W. and Williams, F. H. and Mountain, R. W.
See also, HILL, G. *Tunnel and Dam. The Story of the Galloway Hydros.* S.S.E.B., 1984.

[21] BLYTH, E. L. I. Description of the Loch Ken Viaduct. *Min. Proc. ICE*, **XXI**, Sess. 1861–62, 258–264, pl. 3.

[22] MCCRAE, K. The Parton Privy. *PHEW Newsletter.* Institution of Civil Engineers. **57** (March, 1993), 5–6.

[23] Kircudbright Road Trust Minutes at Ewart Library, Dumfries, section on B795.

[24] CAMPBELL, L. & GARNETT, W. *The life of James Clerk Maxwell*. Macmillan, London, 1882. 323–324.
[25] ANDERSON, A. D. The development of the road system in the Stewartry of Kirkcudbright, 1590–1890. *Trans. Dumfriesshire & Galloway Nat. Hist. & Antiqrn. Soc*, 3rd ser., **XLV** (1968), 212–219.
[26] Kircudbright Road Trust Minutes, at Ewart Library, Dumfries. Classified summary compiled by A. Anderson 2005. Section on A75 – Threave Bridge.
[27] STELL, G. Southerness Lighthouse. *Trans. Dumfriesshire & Galloway Nat. Hist. & Antiq, Soc.* 3rd ser., **LIX**, 1984, 64–69.
[28] *Dumfries & Galloway Saturday Standard*, 1 Jan. 1876.
[29] SMEATON, J. *Reports*. Longman, Hurst, Rees, Orme and Browne, London, 1812. **I**. 1–6.
[30] Information from Dumfries Council archives.
[31] MCDOWALL, W. *History of the Burgh of Dumfries*, 3rd edn. Edinburgh, Hunter & Co., Dumfries, 1906, 44, 45, 857.
[32] MASTERTON, G. G. T. Strengthening, widening and rehabilitation of Buccleugh Bridge, Dumfries. Paper 2, *Symp. on Strengthening and Repair of Bridges*. Construction Marketing, Leamington Spa, 23 June 1988.
[33] DINARDO, C. & BALLIGALL, J. R. Major concrete repairs and restoration of factory structure, Uniroyal, Dumfries**,** *Jnl I. Struct E.*, 17 May 1988, 151, 160.
[34] Glasgow, Dumfries & Carlisle Railway minute books, at National Archives of Scotland (West Register House, Edinburgh). GDU/1/3.
[35] GROOME, F. H. (ed.) *Ordnance Gazetteer of Scotland*. Jack, Edinburgh, 1901, 391.
[36] ROBERTSON, J. *The Public Roads and Bridges in Dumfriesshire*, G. C. Book Publishers Ltd, Wigtown, 1993, 222–237.
[37] RUDDOCK, T. & HENDERSON, D. A. *Biographical Dictionary of Civil Engineers in Great Britain and Ireland Volume 1; 1500–1830*. Thomas Telford, London, 2002, 314.
[38] WYLIE, J. C. Reprinted from *Waste Treatment*. Pergamon Press London, 1958, 349–366.
[39] TELFORD, T. *Life*, Op. cit. 178–180, 473–485.
[40] *Tenth Report of the Commissioners for Repair of Roads and Bridges in Scotland*. House of Commons, 25 Mar. 1824, 9, pl.
[41] *A74 Upgrading to Motorway*. Progress review to mark the official opening of four sections of the motorway from Dinwoodsie Green to Ecclefechan. The Scottish Office Industry Dept. [Edinburgh?], 22 Sept. 1994, viii, 54.
[42] ROBERTSON, J. Op. cit. 260.
[43] MILLER, N. & M. The Carlisle to Glasgow Road. *Trans. Dumfriesshire & Galloway Nat. Hist. & Antiqrn. Soc.* 3rd ser. **LXV**, 1990, 100–105.
[44] ROBERTSON, J. Op. cit. 186–188, 263, 265.
[45] MAIR, C. *A Star for Seamen – The Stevenson Family of Engineers*. Murray, London, 1978, 120.

[46] PAXTON, R. An assessment of aspects of the work of the Stevenson engineers. Ph.D. thesis, Heriot-Watt University, 1999, 134.
[47] STEVENSON, D. *Life of Robert Stevenson*. A. & C. Black, Edinburgh, 1878, 160, pl. VI.
[48] PAXTON, R. *PHEW Newsletter*, **73**, March 1997, 2.
[49] SMILES, S. *Lives of the Engineers*, **II**, Murray, London, 1862, 302.
[50] PAXTON, R. A. The Evolution of Bridge Building in Scotland to 1900. *Civ. Engng Technology*, **8**, No. 4, Aug. 1983, 11–12.
[51] STELL, G. *Exploring Scotland's Heritage Dumfries and Galloway*. RCAHMS, Edinburgh, 1986, 28 (including drawings).
[52] TELFORD, T. *To Sir John Malcolm on Receiving his Miscellaneous Poems*. (ed. R. Paxton), Tragara Press, Edinburgh, 1971.
[53] PASLEY, C. W. *Min. Proc. ICE*. **III**, Sess. 1844, 211–212.