



Part I

Dynasty of Engineers

The Stevensons – Biographical Articles

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Thomas Smith (1752–1815)
Robert Stevenson (1772–1850)
Alan Stevenson (1807–1865)
David Stevenson (1815–1886)
Thomas Stevenson (1818–1887)
David Alan Stevenson (1854–1938)
Charles Alexander Stevenson (1855–1950)
(David) Alan Stevenson (1891–1971)

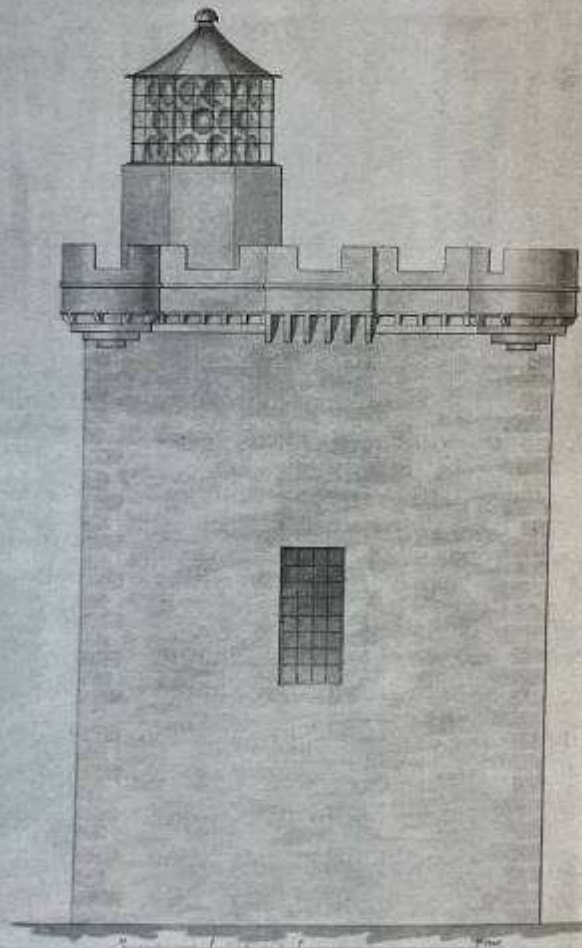
with

Robert Louis Stevenson (1850–1894)
[from *Bright Lights: the Stevenson Engineers*
(2)]

and

Chronological lists of Stevenson private firms
and Northern Lighthouse Board Engineers 1787–
2010

THE FIRST LIGHTHOUSE ERECTED BY THE COMMISSIONERS OF NORTHERN LIGHTHOUSES
MDCCLXXXVII.



NORTHERN LIGHTS

KINNAIRD HEAD LIGHTHOUSE

*Erected under the
Act of 1786.
Geo. III. cap. 101.*

*Lighted in 1787.
THOMAS SMITH*

1st ENGINEER TO THE BOARD.

WAS RENOVED IN 1822 BY ROBERT STEVENSON, ESQ.

His Son in Law

2nd ENGINEER TO THE BOARD.

AND

CONVERTED TO THE DIOPTRIC SYSTEM

In 1851 By

ALAN STEVENSON, LL.B.

3^d ENGINEER TO THE BOARD.

The first lighthouse erected by the Commissioners of Northern Lighthouses 1787, Thomas Smith, Engineer. [A Stevenson office drawing of 1851 or later] (2, 154). © NMS

THOMAS SMITH

1752–1815

Thomas Smith (*bap.* 1752, *d.* 1815), lighting engineer, was baptized on 6 December 1752 in Ferryport-on-Craig, Fife, a small village opposite Dundee. He was the son of mariner, Thomas Smith, and his wife, Mary Kay. In 1764 Smith was apprenticed at Dundee to a metalworker named Cairns, after which he went to Edinburgh (probably in 1770), as a journeyman metalworker, when building of the ‘new town’ was in progress. By 1781 he was trading as a tinsmith from Bristo Street, where he manufactured oil lamps, brass fittings, fenders, and other household metal articles. His business prospered and by 1790 he had moved to premises in Blair Street, where he employed a larger workforce. He was elected to the Edinburgh Guild of Hammermen in 1789 and became its master and a city magistrate in 1802.

On 19 February 1778 Smith married Elizabeth Couper (1758–1786), daughter of a Liberton farmer. After her death, on 20 October 1787, he married Mary Jack (1762–1791). In the year following her death, on 14 November 1792, Smith married Jean Hogg, *née* Lillie (1751–1820). Jean Lillie had previously been married (in 1771), to Alan Stevenson (1752–1774) and to James Hogg, an Edinburgh gunsmith (in 1777), whom she divorced in 1792.

Smith took an interest in improving the illumination of lighthouses in 1786, before the Board of Commissioners of Northern Lighthouses was formed in the same year to improve the almost non-existent lighting of Scotland’s coast. He had proposed to the Edinburgh chamber of commerce that a lamp with metallic reflectors be substituted for the coal light at the old private lighthouse on the Isle of May, but they declined their support. On 16 June 1786 Smith wrote: ‘A comparative view of the superior advantages of lamps above coal light when applyd to light houses’, in which he confirmed that he had ‘constructed 2 small reflectors & lamp with a view to demonstrate by experiment what has been only laid down in theory’ (NLS, MS Acc. 10706, 88). He then petitioned the Edinburgh Board of Manufactures on the utility of such lamps and they resolved to allow £20 towards the expense of making a model of a reflector lamp and trying an experiment on Inchkeith: a trial that is believed to have been successful. The Northern Lighthouse Board appointed Smith as their first Engineer on 22 January 1787.

After receiving instruction in lighthouse construction and illumination in Norfolk from Ezekiel Walker of King’s Lynn, Smith enthusiastically set to work in 1787. He worked, without payment, on the provision of new lighthouses for the Northern Lighthouse Board until 1793 when he was awarded a salary of £60 per annum and his expenses. The Board did not regard his lack of building and architectural experience as an impediment.

During the next two decades Smith was responsible for providing or improving 13 lighthouses, commencing in 1787 with the conversion of Kinnaird Castle into a lighthouse and followed by the Mull of Kintyre (1788), North Ronaldsay (1789), Eilean Glas (1789), and Pladda (1790) lighthouses. Independently of the Board he was responsible for harbour lights at Leith and Portpatrick, and on the Clyde and Tay rivers. His last major lighthouses were Start Point, Orkney (1802–06) and Inchkeith (1804), both for the Board, and Little Cumbrae (1793), for the Clyde Lighthouses Trust.

From 1797 Smith delegated most lighthouse matters to his apprentice and stepson Robert Stevenson, who married his daughter Jane, and established the Stevenson dynasty of engineers which practised until 1952. Stevenson formally succeeded him as Engineer to the Northern Lighthouse Board on 12 July 1808. This enabled Smith to concentrate on lamp manufacture and the expansion of his shipping and other interests, particularly his general and street lighting business. By 1800 his lamps were lighting much of eastern Scotland and the central belt as far west as Glasgow. In 1804 he was the public lighting contractor for both the Old and New towns of Edinburgh and, by 1807, for lighting the streets of Perth, Stirling, Ayr, Haddington, Aberdeen, and Leith (in 1810). In 1808 Smith retired from the business which was then carried on by his son James.

Smith developed and made arrays of parabolic reflector oil lamps. Each lamp had a light source at its focus and a curved reflector formed of small pieces of mirror glass set in plaster that produced a beam of light. His first light, at Kinnaird Head, had an intensity of about 1000 candlepower, which, although feeble compared with its modern counterpart of 690,000 candlepower, nevertheless represented a worthwhile improvement on coal lights. He retained glass-faceted reflectors for new lights until 1801, after which, because of Robert Stevenson's influence, he started to manufacture Argand lamps with silvered copper reflectors. This improvement, which produced a significantly brighter light, is believed to have been first installed in Scotland at Inchkeith Lighthouse in 1804.

Details of Smith's reflectors became more generally known from an article 'Reflector for a Light-house' in the supplement to the third edition of *Encyclopaedia Britannica* (1801). In it Smith is described as 'an ingenious and modest man [who] has carried [his inventions] to a high degree of perfection without knowing that something of the same kind had been long used in France'. This tribute was omitted from later editions, including the last carrying the article (1823), after the editor had learned of Ezekiel Walker's prior development of the glass facet reflector lamp concept. Nevertheless, Smith was the first to introduce brighter lights into Scottish lighthouses, and has a good claim to be regarded as Scotland's first lighting engineer. He died on 21 June 1815 at 1 Baxter's Place, Edinburgh, and was buried in the Old Calton Cemetery.

Sources

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Archives

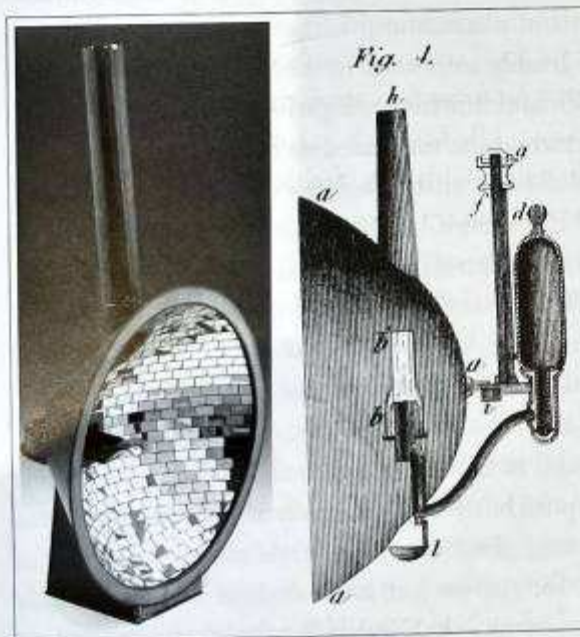
Edinburgh City Archives, Chamber of Commerce at Edinburgh MSS · *NA Scot., Board of Manufactures and Carron Co. MSS* · *NA Scot., Northern Lighthouse Board minute books* · *NLS., Business Records of Robert Stevenson & Sons, Civil Engineers, MS Acc. 10706*

Wealth at death

Approx. £26,000: Private information



Incbkeith Lighthouse tablet 1804 (2, 21).



Left: Model of Smith's multi-faceted glass reflector lamp [National Museums of Scotland ref. 1868. L19. Neg. 13744] © National Museums of Scotland with a section of an early nineteenth-century continuous silvered-copper reflector lamp with Argand burner and wick. (3, pl. XX)

ROBERT STEVENSON

1772–1850

Robert Stevenson (1772–1850), civil engineer, was born in Glasgow on 8 June 1772. He was the only child of Alan Stevenson (1752–1774), a West India merchant, and his wife, Jean Lillie (1751–1820). Two years later his father died of fever in St Kitts, leaving his family in straitened circumstances, and Stevenson was educated at a charity school in Edinburgh. In 1786 he was apprenticed to an Edinburgh gunsmith and was himself described as a gunsmith about 1791. At about that time he began work for Thomas Smith (bap. 1752, d. 1815), an Edinburgh tinsmith, lampmaker, and merchant who, following his invention of a light reflector, had been appointed Engineer to the newly formed Northern Lighthouse Board in 1787. Smith married Stevenson's mother in 1792 and became his father-in-law when Stevenson married his daughter Jane (c.1779–1846) on 3 June 1799.

During the winters of 1792–94 Stevenson attended Professor John Anderson's classes in natural philosophy at Glasgow University and was directed by him towards an engineering career. From 1796 until 1802 he was apprenticed to Smith, specializing in lighthouse work, and gained experience on reflector installation, building maintenance, and construction of the Pentland Skerries and Little Cumbrae lighthouses. From 1797 Stevenson exercised considerable autonomy in the firm's lighthouse work including the construction of Inchkeith and Start Point lighthouses. By 1802 he had been taken into partnership by Smith, whom he succeeded as Engineer to the Board in 1808. During the winters of 1800–04 Stevenson continued to develop an engineering career by attending classes at Edinburgh University in mathematics, natural philosophy, chemistry, and natural history. During this period he was also trying to gain approval for the Bell Rock Lighthouse project 11 miles off Arbroath, which was to prove his most important engineering achievement.

In 1799, following a storm in which many ships were wrecked, Stevenson had proposed erecting on the Bell Rock a beacon-style lighthouse on cast-iron pillars. In 1800 however, after seeing that the rock was submerged by about 12 feet at each high tide, and considering the possibility of damage by ships, he abandoned this idea in favour of a more substantial lighthouse to be made of stone. As part of the design and promotional process for the project both designs were accurately modelled, a practice which Stevenson often employed subsequently on important work. Because of the hazardous and expensive nature of the project it was only after the Board had obtained the support of the eminent engineer John Rennie in 1805 that the necessary act of parliament was passed in 1806. Rennie was appointed Chief Engineer and with Stevenson as Resident Engineer the lighthouse was constructed in 1807–11.

Rather than in its design, the great achievement of the work was in the exceptional difficulty of its execution, which was carried out by Stevenson and his dedicated workmen. The design at Rennie's insistence was more closely modelled on Smeaton's Eddystone Lighthouse than Stevenson's proposal, and this was particularly evident in respect of its external shape. Stevenson also had been strongly influenced by the Eddystone design and improved on it in detail with cantilevered and bonded, instead of flat-arched floors to compartments – an innovation [as approved and developed by Rennie – see page 77] adopted in subsequent rock lighthouses. Rennie recognized the importance of Stevenson's role when he wrote to him in 1807 that the work 'will if successful, immortalise you in the annals of fame' (Stevenson, Biographical Sketch, 10). Innovations introduced under Stevenson's direction included the temporary beacon barrack, elevated cast-iron railways across the rock, and the ingenious movable jib and iron balance cranes, (records indicate these were invented by foreman millwright Francis Watt who also designed the barrack as built). The success of the work enabled Stevenson, from 1811, to establish within a decade one of Scotland's leading indigenous civil engineering practices. With his descendants, he practised engineering continuously until 1952. His classic *Account of the Bell Rock Light-house* was published in an edition of 300 copies in 1824 and he can be considered to have attained the first rank of his profession shortly thereafter. The lighthouse is still in service, but unmanned.

As Engineer and Chief Executive to the Northern Lighthouse Board in 1808–43, Stevenson can be said to have inaugurated the modern lighthouse service in Scotland. He designed and constructed at least 18 lighthouses including Toward Point (1812), Isle of May (1816), Corsewall (1817), Point of Ayre and Calf of Man (1818), Sumburgh Head (1821), Rhinns of Islay (1825), Buchan Ness (1827), Cape Wrath (1828), Tarbat Ness and Mull of Galloway (1830), Dunnet Head (1831), Douglas Head (1832), and Girdle Ness, Barra Head, and Lismore in 1833. Stevenson developed Smith's work on lighthouse illumination and brought the catoptric system, using silvered copper parabolic reflectors and Argand lamps, to a high degree of perfection. With the increasing number of lights it became necessary to distinguish between them, and to this end he devised intermittent and flashing lights.

Marine engineering represented the largest element of Stevenson's general practice. He proposed improvements at numerous harbours including Dundee, Peterhead, Stonehaven, Sunderland, Fraserburgh, and Granton, and river navigation schemes for the Forth, Tay, Severn, Mersey, Dee, Ribble, Wear, Tees, and Erne. Many of these proposals were implemented. He also reported on ferry crossings of the Forth, Tay, Dornoch and Pentland firths, and the Severn, and on fisheries. Stevenson's state-of-the-art marine work included the design and construction in 1821 of a sea wall with a cycloidal-curve vertical profile which dissipated wave energy more effectively

than common walls. His experiments on the destruction of timber by the *Limnoria terebrans* influenced the universal adoption of greenheart for marine timberwork. In Aberdeen in 1812, he discovered that salt water from the ocean flowed up river in a distinct layer from the fresh water which overflowed it. This led to his invention of the 'hydrophore' or water sampler for procuring samples, to further experiments, and to his Royal Society of Edinburgh paper 'On Vertical Differences of Salinity in Water' (1817). His 'Observations upon the Floor of the North Sea' delivered to the Wernerian Society, were published in 1817 and 1820. Stevenson was joined in partnership of the firm by his sons Alan Stevenson (in about 1832) and David Stevenson (1838). In 1846, Thomas Stevenson became a partner on his father's retirement.

From 1811 to 1827 Stevenson was extensively engaged on canal, road, and railway projects, often adopting a promotional role. Before 1818 he made proposals for canals on one level between Edinburgh and Glasgow and also in the Vale of Strathmore. In 1828 he worked with Telford and Nimmo on a proposal for a new harbour at Wallasey and a ship canal across the Wirral to the Mersey. None of these schemes were executed but he was more successful with road making and in his advocacy of stone tracks in city roads.

By 1818 Stevenson was convinced of the superiority of railways over small canals for inland communication and proposed the Edinburgh Railway to connect with the Midlothian coalfield. In 1819 he advised on the line for the Stockton and Darlington Railway. By 1820 he was the leading authority on horse-traction railways in Scotland and he edited, with notes, the numerous 'Essays on Rail-roads' submitted to the Highland Society, which were published in 1824. By 1836 he had worked out various railway schemes to traverse eastern Scotland from the Tweed to Perth and Aberdeen, and from Edinburgh to Glasgow via Bathgate. These were more or less on the lines of the eventual railway network, but the financial climate was unfavourable and the necessary finance for their implementation was not forthcoming. The only scheme actually constructed was the short Newton Colliery Railway to Little France near Edinburgh. Stevenson's design practice was basically the same as he had adopted for canals: to plan his railways as near level as practicable, using stationary steam-engine powered inclined planes to overcome differences in level. In 1818 he advocated the use of 12 feet long malleable iron edge-rails in preference to the much shorter and weaker cast iron rails then prevalent. Three years later George Stephenson acknowledged Stevenson's influence on Birkinshaw's epoch-making development (the malleable iron forerunner of the modern steel rail) and wrote to him 'you have been at more trouble than any man I know of in searching into the utility of railways' (Stevenson, Biographical Sketch, 27).

Stevenson was also a notable bridge engineer and highway planner. He designed and constructed many bridges throughout Scotland including, over the Clyde at

authority, now represent a valuable historical resource. His membership of learned societies seems to have commenced with that of the Highland Society in 1807. By 1812 he was a member of the council of the Wernerian Natural History Society and in the following year a founder director of the Astronomical Institution of Edinburgh. In 1815 he was elected to fellowships of the Royal Society of Edinburgh, the Geological Society, and the Society of Antiquaries of Scotland. Six years later he became a founder member of the Scottish Society of Arts and in 1827–28 was elected to membership of the Smeatonian Society of Civil Engineers and the Institution of Civil Engineers.

Prominent points of Stevenson's character, noted by his sons, were his sagacity, fortitude, perseverance, unselfishness, generosity, a high sense of duty, and his extensive and unwearied exertions in forwarding the progress of young professional men. He was a member of the Church of Scotland and an elder, first at St Mary's, Edinburgh, from 1828–43 and afterwards at Greenside parish church. He died at his home, 1 Baxter's Place, Edinburgh, on 12 July 1850 and was buried in the New Calton Cemetery. An affectionate portrait is given by his grandson Robert Louis Stevenson (Stevenson, Records).

Sources

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Archives

NLS, Business Records of Robert Stevenson & Sons, Acc. 10706

Likenesses

J. Syme, oils, c.1833, Scot. NPG [see illus.] · T. Dick, engraving, c.1840 [1834?] (after J. Syme), priv. coll. · S. Joseph, marble and bronze (?) bust, Northern Lighthouse Board, 84 George Street, Edinburgh · S. Joseph, plaster bust, Scot. NPG · Plaster bust (after S. Joseph), Scot. NPG

Wealth at death

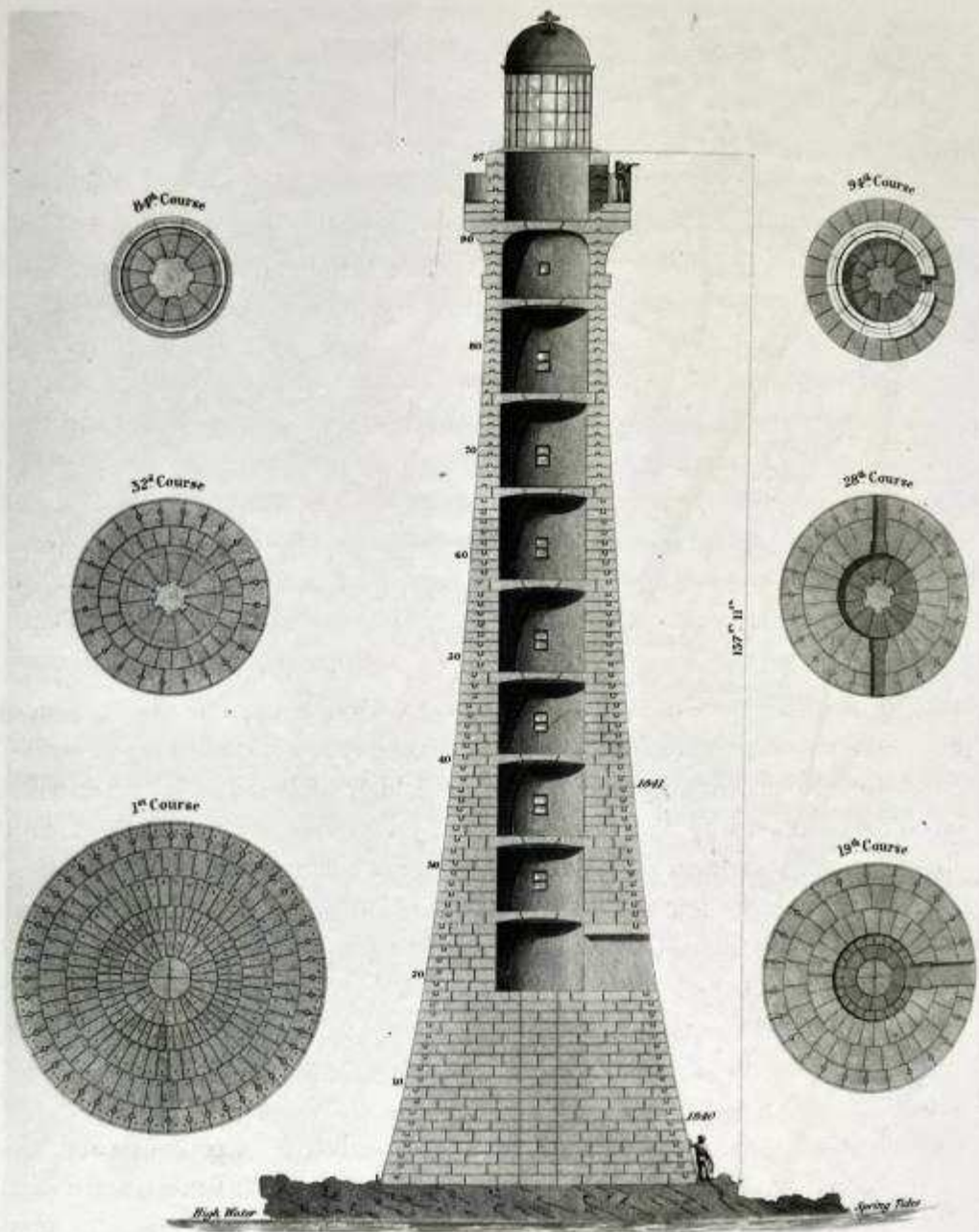
£15,154 13s. 5d.: NAS.

Glasgow, Hutcheson Bridge (1832–68) and a temporary but notably wide fourteen-span timber bridge (1832–46). The former, which had to be replaced because of Clyde navigation deepening, was considered one of the best specimens with segmental masonry arches. So was Stirling Bridge which still stands, Stevenson also planned its town approach. This approach is not as imposing as his earlier London and Regent Road approaches into Edinburgh. These skirt Calton Hill, and include the Regent's Bridge with its open parapets, which enable users to enjoy the view. Stevenson was also responsible for making these roads, which involved blasting, rock excavation, and building a massive retaining wall.

Segmental arches characterize Stevenson's masonry bridges, fine examples of which still exist at Marykirk, built in 1812, and Annan, in 1824. He adopted segmental arches in major proposals for cast iron additions to Newcastle upon Tyne, Perth, and Edinburgh North bridges, but none was executed. Stevenson's innovative designs for other types of bridges included a laminated timber arch for Dornoch Firth in 1830. From 1821, he proposed a new type of medium-span suspension bridge without towers for numerous locations. This design was novel in that the roadway superstructure rested on the catenarian chains rather than being suspended from them. It was widely publicized in Stevenson's authoritative 'Bridges of Suspension' article published in the *Edinburgh Philosophical Journal* (1821), and translated into French, German, and Polish. By 1850, numerous small-span bridges on this basic principle were subsequently executed in Britain and on the continent. Although not implemented as intended, Stevenson's proposals, together with details of his Glasgow and Stirling bridges, were widely disseminated through John Weale's *The Theory, Practice and Architecture of Bridges* (1839). They undoubtedly influenced subsequent bridge-building practice nationally and more unusual structures upon which Stevenson advised, were the cracked steeple of Montrose church, Arbroath Abbey, and the Melville Monument in Edinburgh.

Stevenson had a lifelong interest in gaining and promoting knowledge and his writings appeared in more than 60 publications. Many were engineering reports, but about one-third achieved much wider circulation through leading periodicals and encyclopaedias. He contributed significant articles to the *Edinburgh Encyclopaedia* between 1810 and 1824, entitled 'Bell Rock', 'Eddystone Rocks', 'Inchkeith', 'Light house', 'Roads and Highways', and 'Railway'. He contributed 'Bell Rock Light house', 'Blasting', 'Caledonian Canal', and 'Dredging' to the *Encyclopaedia Britannica* between 1816 and 1819.

In 1817 he wrote a lively and informative series of letters to his sixteen-year-old daughter, Jane, while on a tour through the Netherlands; these were of sufficient interest to be published in the *Scots Magazine* (1818–21) and separately as *Journal of a Trip to Holland* (1848). Many of Stevenson's publications, because of their depth and



Alan Stevenson's Skerryvore Lighthouse – one of the world's most finely proportioned, dubbed by R. L. Stevenson the 'noblest of all deep sea lights' (5). Tower 155ft high, weight c.4100 tons, with hyperbolic side curvature. Note: Foundation above High Water – lower courses undovetailed. (4, pl. VIII)

ALAN STEVENSON

1807–1865

Alan Stevenson (1807–1865), civil engineer, was born on 28 April 1807 in Edinburgh. He was the eldest surviving son of Robert Stevenson, the brother of David Stevenson and Thomas Stevenson and the uncle of Robert Louis Stevenson. Educated at the High School and University of Edinburgh, where from 1821 he read Latin, Greek, and mathematics with a view to entering the church. In 1823 Stevenson decided to follow an engineering career and, after six months at the Revd Pettingal's Twickenham Finishing School, he commenced a four-year apprenticeship to his father (a civil engineer). During each winter he attended classes at Edinburgh University appropriate to his career and in 1826 he graduated MA. Under Sir John Leslie (1766–1832), professor of natural philosophy, he gained the Fellowes prize for excellency as an advanced student of natural philosophy. In the same year he read his first paper to the Royal Physical Society of Edinburgh, on the 'causes of obscurity in style', urging for greater clarity in writing.

Stevenson's thorough training from 1823–27 included railway surveying under William Blackadder of Glamis; bridge building, river improvements, harbour and lighthouse engineering under his father's direction; and a study tour of works in Sweden and Russia with the engineer Robert Bald. In 1828–29 he gained experience on works conducted by Thomas Telford and James Walker at Hull docks, on the Birmingham Canal under its Resident Engineer, William Mackenzie, and on a new dock at Liverpool. Encouraged by his father, and with access to his notes, Stevenson compiled a list of British lighthouses, describing their appearance at night. This pocket-book list, the first of its kind, published at Leith in 1828 as *The British Pharos* (2nd edn, 1831), was very useful to mariners.

In 1830 Stevenson, in addition to being an assistant in his father's firm, was appointed clerk of works to the Northern Lighthouse Board, to which his father was Engineer. During the following three years he worked on new lighthouses at the Mull of Galloway, Dunnet Head, Douglas Head, Barra Head, Girdleness, and Lismore. For some years Stevenson had been interested in improving lighthouse illumination and in the summer of 1834 he visited lighthouses and workshops in France. There he gained knowledge of the work of the Fresnel brothers – Augustin (1788–1827) and Léonor (1790–1869), Jean Baptiste François Soleil (1798–1878) and Bordier-Marcet Issac-Ami, (1768–1835). In particular, he studied Fresnel's dioptric apparatus which used lenses instead of mirror reflectors to enhance light intensity.

In the following year Stevenson's influential Report 'On Illumination of Lighthouses by Means of Lenses', which included a valuable account of French practice, was published. In 1835 under his direction, the revolving light at Inchkeith and in

1836 the fixed light of the Isle of May were made dioptric instead of catoptric, with a resulting threefold order of increase in brightness. Furthermore, for Trinity House in 1836 Stevenson designed and superintended the installation of the first dioptric light in England at Start Point, Devon.

In around 1832 Stevenson was taken into partnership in his father's firm. From 1832 to 1837, he and his father were engaged in work which included, preparation of 'A Chart of the Coast of Scotland', Ballyshannon harbour improvement, Granton harbour, plans for Edinburgh and Glasgow, Edinburgh and Dundee, and Perth and Dunkeld railways, Perth harbour, and Tay and Ribble navigation improvements. Soon afterwards he wrote an authoritative account of 'sea lights' from their earliest development to about 1838 which was published in the seventh and eighth editions of the *Encyclopaedia Britannica* (1840 and 1857). From December 1837 until August 1843, Stevenson was almost exclusively employed by the Northern Lighthouse Board on the design and construction of Skerryvore Lighthouse. This being mutually agreed as too arduous a task for his father who was by then sixty-five.

In January 1843 Stevenson succeeded his father as the Board's Engineer. From then, until paralysis dictated his retirement in 1853 he was responsible for the design and construction of new lighthouses. In addition to Skerryvore, these included Little Ross, Covesea Skerries, Chanonry Point, Cromarty, Cairn Point (Loch Ryan), Noss Head, Ardnamurchan, Sanda, Heston Island, Hoy, and Arnish Point, Stornoway. On 11 September 1844 he married Margaret Scott (1813–1895), daughter of Humphrey H. Jones of Llynnon, Anglesey and his wife, Jean, *née* Scott. They had one son – the art critic Robert Alan Mowbray Stevenson (1847–1900) – and three daughters including the author Katharine de Mattos.

Stevenson's national reputation was mainly based on his design and execution of Skerryvore Lighthouse. His classic account, was, together with his notes on lighthouse illumination, published in an *Account of the Skerryvore Lighthouse* (1848). These notes were extended and more widely propagated through *A Rudimentary Treatise on the History, Construction and Illumination of Lighthouses* (1850). Both works were considered of outstanding technical value well into the twentieth-century. Skerryvore Lighthouse was a great engineering achievement and is still in service. It stands 155ft high, located on an isolated reef 12 miles west-south-west of Tiree and exposed to the full fetch of the Atlantic.

The first season's work, the beacon-barrack erected in 1838, was totally destroyed by a November storm. The eventual creation of the lighthouse by 1843 severely tried Stevenson's courage, patience, and health and fully exercised his undoubted ability. The lighthouse has been widely acknowledged to be the finest example for mass combined with elegance of outline of any rock tower. Stevenson adopted for its shape the hyperbolic curve which was the form with the least mass and lowest centre of gravity of the various options examined. It strongly influenced the design of

the Alguada Lighthouse built for the Indian government in 1862–65. Skerryvore's revolving dioptric apparatus was the most advanced in the world at that time, with prismatic rings instead of mirrors below the central belt, thus greatly extending the improved dioptric effect. Stevenson further improved its efficiency by introducing inclined astragals into the lantern. His improvements to the dioptric system, which included the conversion of Fresnel's narrow lenses in fixed systems into a truly cylindrical drum, led to its wider adoption. He introduced prismatic rings above and below the central belt, thus securing equal distribution of light all round and extending dioptric action through the whole height of the apparatus.

In 1830 Stevenson, sponsored by Telford, became a corresponding member of the Institution of Civil Engineers, and in 1838 a fellow of the Royal Society of Edinburgh, acting as a member of its council in 1843–45. In 1840 the University of Glasgow conferred on him the honorary degree of LL.B. The emperor of Russia and the kings of Prussia and the Netherlands presented him with medals in acknowledgement of his merit as a lighthouse engineer. Dr John Brown wrote that Stevenson had genuine literary genius, that he was able to read Italian and Spanish critically and with ease, and that he knew Homer by heart and read Aristophanes in Greek. Clarity and style characterize his writings. In addition to the publications already mentioned, Stevenson contributed papers to the *Edinburgh New Philosophical Journal* and in 1851 his biographical sketch of his father was published (illustrated edn, 1861).

In 1852 Stevenson was seized with paralysis, and in the following year he resigned as Engineer to the Northern Lighthouse Board. He beguiled his suffering in retirement by translating the ten hymns of Synesius, bishop of Cyrene AD 410. These translations, along with other poems, were printed for private circulation in 1865. On 23 December 1865 Stevenson died of general paralysis at his home, 6 Pitt Street, Portobello and was buried in the New Calton Cemetery, Edinburgh. He was survived by his wife and their four children. On 3 January 1866 the Northern Lighthouse Board recorded their deep and abiding regrets for the loss of a man whose services had been to them invaluable and whose works combined profound science and practical skill.

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Archives

NLS, *business records of Robert Stevenson & Sons*, Acc. 10706.

Likenesses

Photograph, repro. [in] Mair, *Star* [better in family group overleaf]

Wealth at death

£9,388 16s. 4d.



*The Stevenson family at Anchor House, North Berwick c. 1860.
David (on right) Alan (centre-middle) with David Alan on his knee and Charles (on his
right with stick) Thomas (back-left) and Robert Louis (front-left, 2nd from end). (2. 161)*

DAVID STEVENSON

1815–1886

David Stevenson (1815–1886), civil engineer, was born in Edinburgh on 11 January 1815. He was the third surviving son of Robert Stevenson and the brother of Alan Stevenson and Thomas Stevenson. He was educated in Edinburgh at the High School in 1824–30 and attended classes at the University in 1831–35 under professors Wallace, Forbes, Hope, and Jameson while undergoing an exemplary engineering training in his father's office. Before commencing his apprenticeship Stevenson gained experience in working with iron and wood with a leading Scottish millwright, James Scott of Cupar, Fife. He was also taught mechanical drawing by James Scott's son, David. In 1832 Stevenson gained experience on bridge works being conducted by his father over the Clyde at Glasgow, and the Forth at Stirling where he dressed at least one arch stone. He gained further experience at the cotton works of James Smith of Deanston (1789–1850), agricultural engineer. In 1833–34 Stevenson's training included surveying for the Tay navigation improvement and with contractor William Mackenzie (1794–1851), setting out and starting work on a 22-mile section of the London and Birmingham Railway in Warwickshire and on the construction of Edgehill Tunnel, Liverpool.

In 1835 Stevenson studied road making in Ireland and diving bell work at Kingstown harbour. He also made a survey of, and supervised, road construction on the Calf of Man. His earliest papers were read to the Royal Scottish Society of Arts on the subjects of the Liverpool and Manchester (1835) and Dublin and Kingstown railways (1836). The former earned him a medal from the society. Late in 1835, aged twenty, Stevenson declined an invitation from Marc Isambard Brunel to work as a resident engineer on the Thames Tunnel, preferring the post of Resident Engineer at Granton harbour. Here he worked under his father on quarry opening, pier construction, and road building. In 1837 he resigned this post and gained wider experience in North America, France, Switzerland, Germany, and the Netherlands. This tour led to the publication of his influential and now historically valuable *Sketch of the Civil Engineering of North America* (1838, 2nd edn, 1859), which influenced the introduction into Britain of faster steam vessels, with fine lines and long-stroke pillar engines and cost-effective timber construction.

In May 1838 Stevenson entered into partnership with his father and brother, Alan, and the firm became known as Robert Stevenson & Sons. As 'managing partner' he immediately became responsible for the entire management of the firm's general business. Work in Scotland included navigational improvement on the Forth, Tay, Clyde, and Nith, and harbour construction. English projects included improvements to the Dee, Lune, Ribble, Wear, and Fossdyke, and in Ireland, the Erne and Foyle.

Other work included Mullagmore and Morecambe harbours, Allanton Bridge, Newfoundland lighthouses, Peebles railway, Birkenhead docks, and opposing railway crossings of the Tay and Dee. On 3 June 1840 Stevenson married Elizabeth (1816–1871), daughter of James Mackay, a goldsmith from Edinburgh. They had four sons and four daughters. Only two sons survived childhood; they were David Alan Stevenson (1854–1938) and Charles Alexander Stevenson (1855–1950) [see under *Stevenson, David Alan*], who continued the family engineering tradition.

Stevenson also advised on salmon fishing disputes and in 1842, in connection with the Dornoch fishings, first categorized the different physical characteristics of a river in to the well-known terms 'sea proper', 'tidal', or 'river proper'. This work led to his paper 'Remarks on the Improvement of Tidal Rivers' read to the Royal Society of Edinburgh in 1845, which was also separately published, under the same title, that year (2nd edn, 1849). In it he argued conclusively that if the duration of tidal influence was extended, the hydraulic head would be lessened and the velocity of tidal currents decreased. Stevenson also correctly propounded the theory of the origin of bars at the mouths of rivers and defined effective measures for their removal. He emphasized the necessity for accurate data upon which to base improvements and wrote *A Treatise on the Application of Marine Surveying and Hydrometry to the Practice of Civil Engineering* (1842). Stevenson's practice of marine engineering was extensively promoted through his article 'Inland Navigation' in the *Encyclopaedia Britannica* (8th edn, 1857) and enlarged into *Canal and River Engineering* (1858). This became a definitive work which continued to be used well into the twentieth-century and established his national reputation.

In 1846, when railway projects (and to a lesser extent public health bills), were overwhelming the Admiralty and Woods and Forests departments, Stevenson held courts of inquiry under the Preliminary Inquiries Act for at least 20 proposed bills. His findings were accepted in every case, except for the Caledonian Railway's proposed crossing of the Clyde at Glasgow. This was at first opposed by the Admiralty but later approved. In 1849–50 he reported on Fishery Board proposals at Lybster and Scallisaig harbours, which led in 1851 to his becoming, at his own request, joint Engineer to the Board with his brother Thomas for over 30 years. In 1853 Stevenson succeeded his brother Alan as Engineer to the Northern Lighthouse Board. During the following year he achieved, under difficult circumstances, the construction of Britain's most northerly lighthouse at North Unst (Muckle Flugga). In 1855, again at his own instigation, he became joint Engineer to the Board with Thomas. In 1855–80 they designed and executed some 28 beacons and 30 lighthouses, two of which, Dhu Heartach (1872) and Chicken Rock (Isle of Man) (1875) were works of particular difficulty on isolated rocks.

The general business of what had become the firm of D. and T. Stevenson continued to flourish under Stevenson's management until his retirement due to ill health in 1884. In addition to marine work the firm was also engaged on public health

improvements, including Edinburgh and Leith sewerage in 1863 – the city's first such major scheme – which involved the construction of the Water of Leith sewer to an outfall in the Forth. Abroad, the firm's lighthouse practice extended to India, New Zealand, and Japan, including the organization of complete systems for the two latter countries.

For Japanese lighthouses in earthquake zones Stevenson devised an 'aseismic' joint to mitigate the effect of shocks on lighting apparatus. However, according to Richard Henry Brunton (1841–1901), the site engineer the firm had recruited, it did not prove effective in practice. Stevenson played a leading part in developing and promoting the use of paraffin in place of the more expensive colza oil in lighthouse illumination (from around 1870). This resulted in enhanced light intensity at a lower cost and considerable savings worldwide.

In 1844 Stevenson was elected a fellow of the Royal Society of Edinburgh (vice-president in 1873–77), and also a member of the Institution of Civil Engineers; he contributed papers to both bodies. Stevenson was also a member of the Société des Ingénieurs Civils, Paris, and other learned societies. He was twice president of the Royal Scottish Society of Arts (in 1854 and 1869), his latter presidential address being entitled 'Altered relations of British and Foreign Industries and Manufactures'. He was also Engineer to the Convention of Royal Burghs of Scotland and to the Highland and Agricultural Society. Other writings by Stevenson included 'Our Lighthouses' in *Good Words* (1864) (which was also separately published in book form in the same year), *Reclamation and Protection of Agricultural Land* (1874), and the definitive life of his father published in 1878. His many interests included the improvement of agricultural implements, better endowment of professorial chairs of the University of Edinburgh, art and art criticism, and the formation of a valuable collection of etchings and engravings.

Stevenson was a man of sound judgement, upright, kind, open, and easily accessible. He died at Anchor Villa, West Links, North Berwick, of apoplexy on 17 July 1886 and was buried at Dean Cemetery, Edinburgh.

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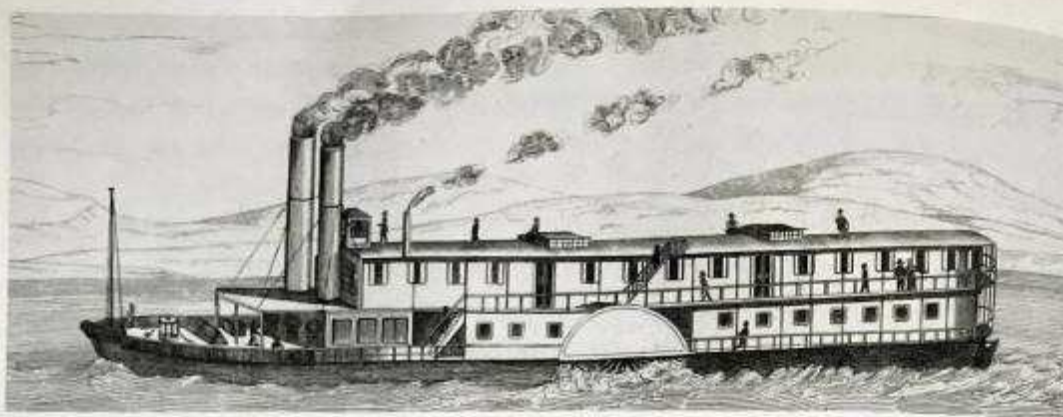
NLS, business records of Robert Stevenson & Sons, Acc. 10706

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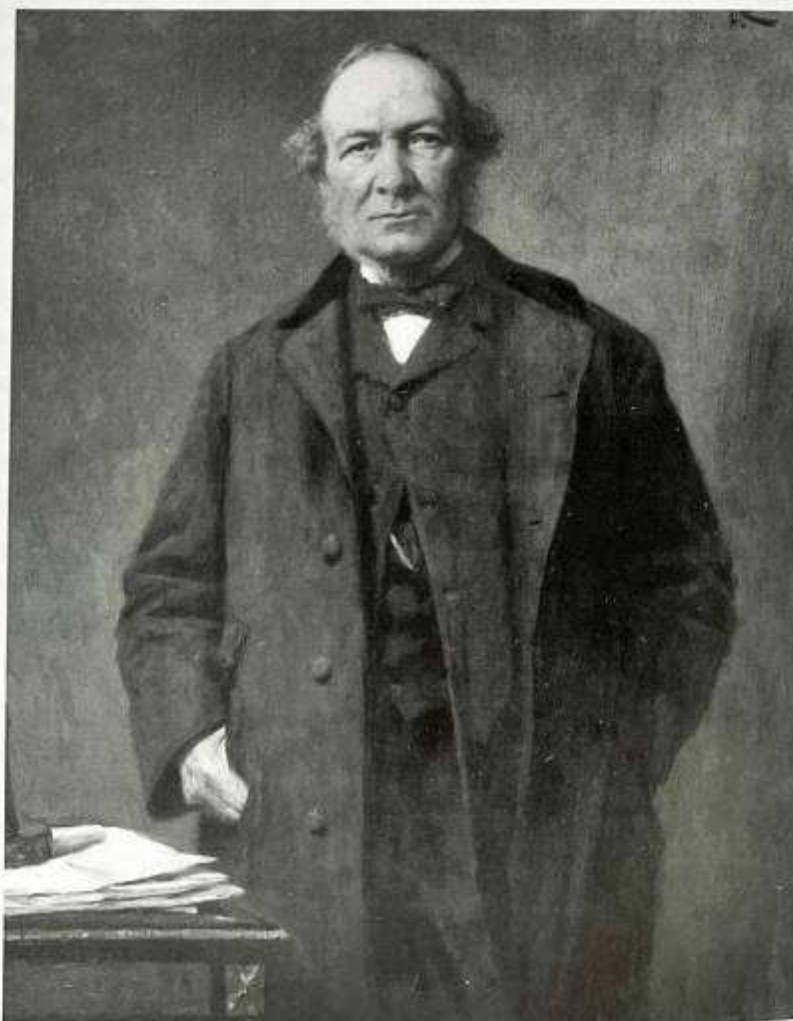
Engraving, repro. [in] Mair, *Craig, Star for Seamen*; (2, 163)

Wealth at death

£55,025 13s. 11d.



Western Water steam-boat on River Ohio, 1837. From David Stevenson's drawing in his Sketch of the Civil Engineering of North America, 1838. [Pl. V].



Thomas Stevenson © The Royal Society of Edinburgh (2, 83)

THOMAS STEVENSON

1818–1887

Thomas Stevenson (1818–1887), civil engineer and meteorologist, was born in Edinburgh on 22 July 1818. He was the youngest surviving son of Robert Stevenson and his wife, Jane, and the brother of Alan Stevenson and David Stevenson. Educated in Edinburgh at Alexander Brown's Preparatory School and at the High School, his performance was unremarkable, except for acquiring a grounding in Latin, which he cultivated and enjoyed in later years. Brown's contagious enthusiasm for English literature found in Stevenson a receptive mind, but the severe discipline which accompanied it initiated his lifelong contempt for formal education. On leaving school he provisionally entered the printing firm of his father's friend Patrick Neill, but he did not pursue a typographical career. Youthful interests included collecting books, writing, and printing some of his essays on his own working model of a 'Columbian' press.

At the age of 17 Stevenson entered the family engineering firm and during a rigorous apprenticeship to his father in 1836–39 he gained experience in harbour, river improvement, and lighthouse work and attended several classes at Edinburgh University. He still found time to write fiction, amounting to a 'drawer full', but when this was discovered by his father he was urged by letter to 'give up such nonsense and mind your business' (Mair, 143). By 1841 Stevenson's book collection is known to have embraced Aesop's *Fables* with Bewick woodcuts, Boece's *Cronicles of Scotland* (1527), and engineering-related works, including Sinclair's *Hydrostaticks* (1672) with skilful pen and ink restoration of missing plates, presumably carried out by its young owner.

From 1839 until 1841 Stevenson combined his talent for writing with engineering in the columns of *The Civil Engineer* and *Architect's Journal*. His annotated copies attest to communications advocating the removal of ruinous buildings by blasting, and restoration rather than replacement of ruinous historic buildings; on the form of river bank profiles; the repair of breaches; and on an improved levelling staff and 'quick-set' level, made to his design. In 1845 he furnished the *Journal* with an abstract of his paper to the Royal Society of Edinburgh on forces exerted by sea-waves, the first significant work on this subject. These contributions, together with the first of numerous articles in the *Edinburgh New Philosophical Journal* (in 1842–43) on defects in rain gauges and the geology of Little Ross Island, were the earliest of more than 60 publications during his lifetime. Many of these demonstrate Stevenson's innate faculty for the quantitative investigation of natural phenomena and artificial constructions which enabled him to advance contemporary knowledge and practice by means of observation and experiment.

On his father's retirement in 1846 Stevenson became the junior partner in the firm, which after a short period as Messrs Stevenson soon became known as D. and

T. Stevenson. In this capacity, he was able for many years to engage effectively in research and development and became a leading authority on lighthouse illumination and harbour engineering. Abroad, the firm's advice extended to lighthouses in India, China, and Newfoundland and to the lighting of the whole coasts of Japan and New Zealand. In Scotland in 1855-84, Stevenson acted jointly with his brother David as Engineer to the Northern Lighthouse Board; they designed and executed some 28 beacons and 30 lighthouses, including Dhu Heartach (completed in 1872) and Chicken Rock (Isle of Man) (completed in 1875), on isolated rocks. He then acted as sole Engineer to the board for nine months and as joint Engineer with his nephew David Alan in 1885-57 until his death.

From 1851 for several decades the firm acted as engineers to the British Fisheries Society and Fishery Board working at Lybster, Wick, Peterhead, and other harbours. Stevenson continued his practical investigations into the generation and force of waves. By 1852 he had formulated a tentative empirical relationship between their height and fetch which was commonly used by engineers for more than a century afterwards as a first approximation. Other experiments led to formulae which enabled the effect of harbours and breakwaters in reducing the height of waves to be calculated. Stevenson's valuable work became widely known through his *Encyclopaedia Britannica* article 'Harbour' (1857) separately published as *The Design and Construction of Harbours* (1864; 2nd edn, 1874; 3rd edn, 1886). The firm's harbour work was almost invariably successful, except for Wick breakwater which, as its construction progressed, proved unable to resist the effect of storm-driven waves in 1872-73 and was eventually abandoned as a costly, but nevertheless most instructive, failure [13].

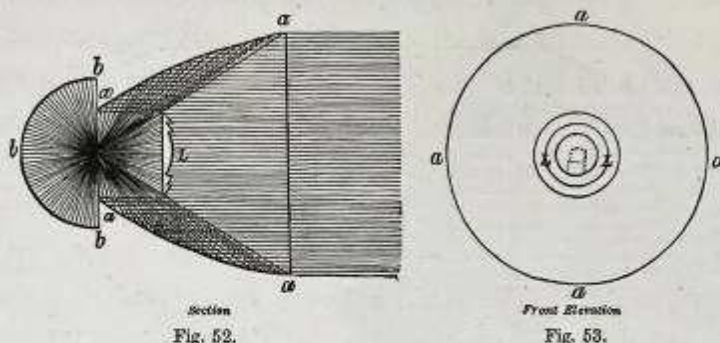
Stevenson's national reputation was based on his harbour work and more particularly on his devices, by which 'the great sea lights in every quarter of the world now shine more brightly' (R. L. Stevenson, *Familiar Studies*, v). These are fully described in his classic work *Lighthouse Illumination* (1859; 2nd edn, 1871), expanded into *Lighthouse Construction and Illumination* (1881). He developed the work of Augustin Fresnel and Alan Stevenson and installed at Peterhead North Harbour Lighthouse in 1849 a catadioptric [reflector and lens-prisms] fixed holophote, that is, a device which was the first to combine the whole sphere of rays diverging from a light source into a single beam of parallel rays. Stevenson then further developed this system by introducing the first dioptric [lens-prisms] holophotal revolving light which was installed at Horsburgh Rock near Singapore in 1850.

This holophotal system, which proved a great improvement in lighthouse illumination, was then adopted on a larger scale by the Northern Lighthouse Board at North Ronaldsay Lighthouse in 1851 and afterwards came into universal use. Stevenson also developed the concept of creating an 'apparent' light on dangerous reefs by indirect illumination and reflection from a parent lighthouse and installed a

HOLOPHOTAL SYSTEM.

81

densing the whole sphere of diverging rays into a single beam of parallel rays, without any unnecessary reflections or refractions. Part of the anterior hemisphere of rays (Figs. 52, 53) is intercepted and at once parallelised by the lens L ,



Section
Fig. 52.

Front Elevation
Fig. 53.

whose principal focus (*i.e.* for parallel rays) is in the centre of the flame, while the remainder is intercepted and made parallel by the paraboloid a , and thus the double agents in Fresnel's and Brewster's designs (17, 19) are dispensed with. The rays of the posterior hemisphere are reflected by the spherical mirror b , back again through the focus, whence passing onwards one portion of them falls on the lens and the rest on the paraboloid, so as finally to emerge in union with, and parallel to the front rays. This was the first instrument which intercepted and parallelised all the rays proceeding from a focal point by the minimum number of

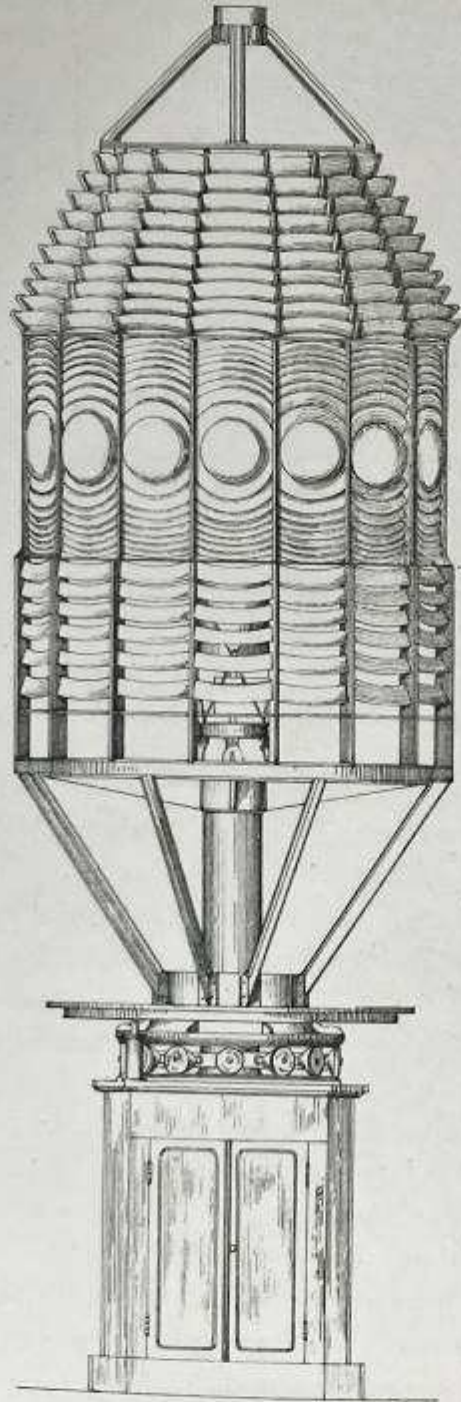
Left: Catadioptric fixed holophote used at Peterhead Harbour in 1849 [Stevenson T. Lighthouse Construction and Illumination, 1881]

'beautiful and ingenious contrivance' ('Report ... Stevenson's Paper on Dipping and Apparent Lights', 291) at Stornoway in 1851. Stevenson's crowning achievement was his 'azimuthal condensing system', which reduced the available light in some sectors of azimuth and optimized it in others. It was introduced at Isle Oronsay Lighthouse, Skye, (1857) to service Sleat Sound. He was assisted in some of the calculations required for his inventions by his cousin and lifelong friend Professor W. Swan and also by Professor P. G. Tait.

In 1848, Stevenson was elected a fellow of the Royal Society of Edinburgh, becoming its president in 1884. He was elected a member of the Institution of Civil Engineers in 1864, a fellow of the Geological Society in 1874, and was a founder member of the Scottish Meteorological Society in 1855, becoming its honorary secretary in 1871. Among the many and permanent contributions which he made to meteorology were the Stevenson screen (for the protection of thermometers, designed in 1864 and now in universal use; the introduction in 1867 of the term 'barometric gradient'; and the means of ascertaining, by high and low level observations at Ben Nevis observatory and elsewhere, the vertical gradients for atmospheric pressure, temperature, and humidity.

ELEVATION OF THE FIRST DIOPTRIC HOLOPHOTAL REVOLVING LIGHT (1ST ORDER)
DESIGNED OCTOBER 1850, FOR NORTH RONALDSHAY,
AND CONTRACTED FOR BY M. LETOURNEAU, ON 3RD JANU, 1851.

PLATE XXIII



Dioptric holophotal revolving light at North Ronaldsay, 1851
[Stevenson T. Lighthouse Construction and Illumination, 1881]

On 8 August 1848, Stevenson married Margaret Isabella (1829–1897), daughter of the Revd Lewis Balfour, minister of Colinton. In her early and middle life Margaret suffered from chest problems. The couple had one child, the writer Robert Louis Stevenson. A devoted member of the Church of Scotland, Thomas Stevenson wrote several religious pamphlets including *Christianity Confirmed by Jewish and Heathen Testimony, and the Deductions from Physical Science* (1877; 2nd edn, 1879). He became ill with an enlarged liver in 1885; eventually he developed jaundice and died at his house, 17 Heriot Row, Edinburgh, on 8 May 1887. He was buried in the New Calton Cemetery, Edinburgh. He was survived by his wife who lived for a time in Samoa with her son.

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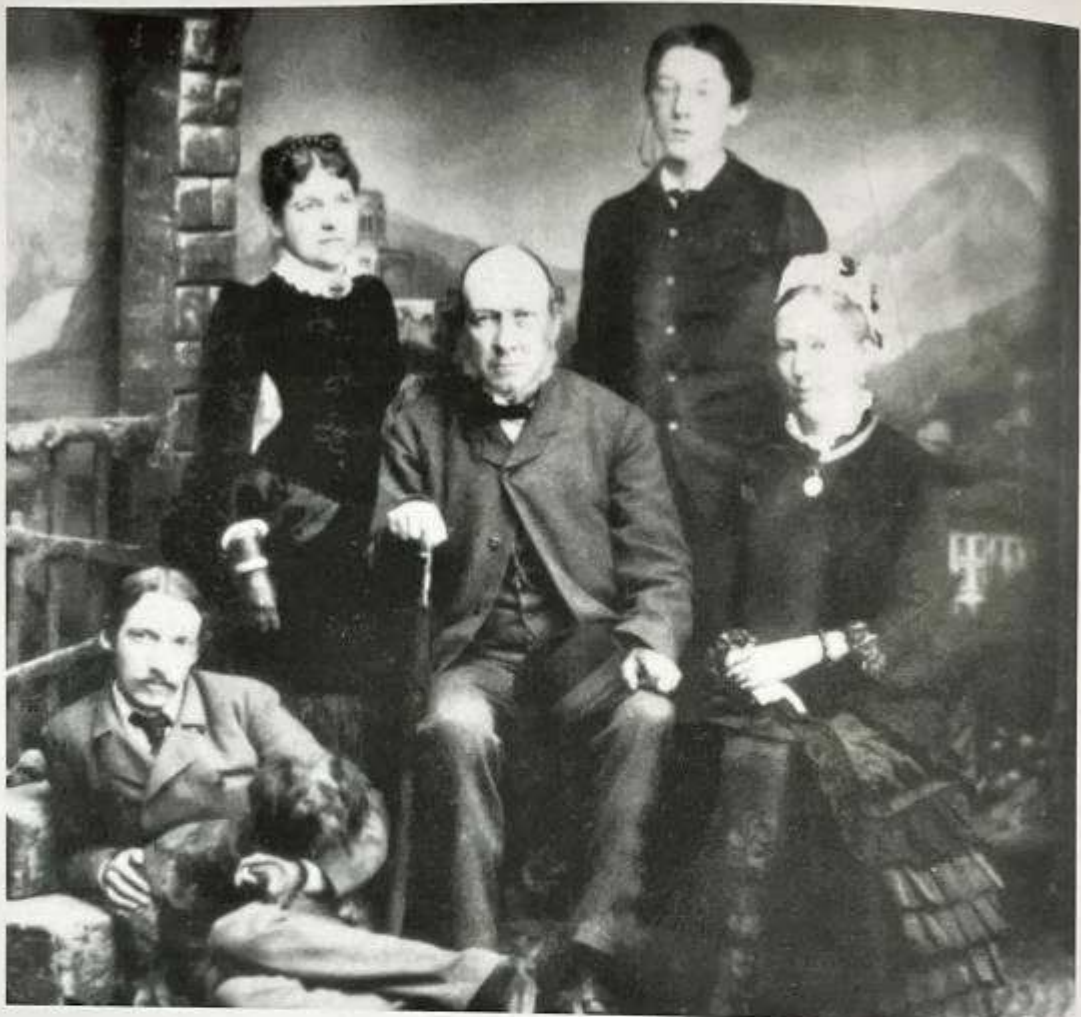
NLS, corresp. with Scottish Society of Arts · NLS, business records of Robert Stevenson & Sons, Acc. 10706

Likenesses

G. Reid, oils, Scot. NPG · Photograph (after G. Reid), Royal Society of Edinburgh · Photograph, repro. [in] Mair, Craig, Star for Seamen: Stevenson Family of Engineers

Wealth at death

£26,918 16s. 11d.: confirmation, 5 Aug 1887, CCI



The Stevenson family in Edinburgh in 1880. Robert Louis and Fanny (left), Thomas and Margaret, and Lloyd Osborne (rear) (2, 81)

ROBERT LOUIS STEVENSON

1850–1894

The following is a reprint of my essay on Stevenson's three and a half years as 'a reluctant trainee civil engineer' in *Bright Lights: the Stevenson Engineers* (2, 99–109).

Although Louis never became a civil engineer, until he reached the age of 21 his parents hoped that he would follow in this family tradition and he was educated accordingly. In November 1867 he took a tentative step in this direction by enrolling as a student in the Arts faculty at Edinburgh University. It was not however until 1869–70 that he studied any engineering related subjects, namely mathematics and natural philosophy. He continued with these in 1870–71 together with the engineering classes of Professor Fleeming Jenkin (1833–85) which, being unable to follow, he refrained from attending.

By April 1871 after some three and a half years of dutifully, if increasingly half-heartedly, pursuing this career he felt unable to continue and announced his decision to give up engineering. This outcome was accepted with disappointment but also with 'wonderful resignation' [R. L. Stevenson. *Letters of ...* (Eds: Bradford A. Booth and Ernest Mehew). Newhaven and London, 1995, 1, 209. Margaret Stevenson's diary, 8 April 1871] by his father who was no doubt recalling similar youthful tussles. They came to the understanding that Louis read for the bar, instead of writing literature, which his father considered no profession! Engineering's loss proved outstandingly to be literature's gain, but Louis's writings benefited immeasurably from his maritime engineering experience both in context and detail.

Some of Louis's published writings even related directly to engineering such as his paper on 'A New Form of Intermittent Light for Lighthouses', his *Memoir of Fleeming Jenkin, Records of a Family of Engineers* and an essay, 'The Education of an Engineer'. Louis and his father enjoyed corresponding on literary matters, each claiming to have improved some of the other's writings. Louis considered that he had 'materially helped to polish the diamond' of his father's presidential address to the Royal Society of Edinburgh in 1885 and 'ended by feeling quite proud of the paper as if it had been mine; the next time you have as good a one, I will overhaul it for the wages of feeling as clever as I did when I had managed to understand and helped to set it clear'. [R. L. Stevenson. *Letters of ...* (Eds: Bradford A. Booth and Ernest Mehew). Newhaven and London, 1995, 5, 68].

Louis's intermittent light paper, read to the Royal Scottish Society of Arts on 27 March 1871, was a creditable effort and earned him a silver medal of the Society. It also prompted his jaunty farewell *To the Commissioners of Northern Lights*, which concluded with the thought that as a future advocate he might one day be a commissioner himself!

*I send to you, commissioners,
A paper that may please ye, sirs,
(For troth they say it micht be worse
An' I believ't)
And on your business lay my curse
Before I leav't.*

*I thocht I'd serve wi' you, sirs, yince,
But I've thocht better of it since;
The maitter I will nowise mince,
But tell ye true:
I'll service wi' some ither prince,
An' no' wi' you.*

*I've no' been very deep, ye'll think,
 Cam' delicately to the brink,
 An' when the water gart me shrink,
 Straucht took the rue,
 An' didna stoop my fill to drink—
 I own it true.*

*I kent on cape and isle, a light
 Burnt fair an' clearly ilka night;
 But at the service I took fright,
 As sune's I saw,
 An' being still a neophite
 Gaed straucht awa'.*

*Another course I now begin,
 The weeg I'll cairry for my sin,
 The court my voice sall echo in,
 An'—wha can tell?—
 Some ither day I may be yin
 O' you mysel'.*

[R. L. Stevenson. *Collected Poems*. (Ed: Janet Adam Smith), London, 1950, 101–102].

Louis's engineering education at Edinburgh University seems to have been characterised more by truancy and a very tolerant Professor Fleeming Jenkin than any serious acquisition of knowledge. Against his better judgement and after much pleading by Louis for a class attendance certificate first told him: 'It is quite useless for you to come to me, Mr. Stevenson. There may be doubtful cases, there is no doubt about yours. You have simply not attended my class' [R. L. Stevenson. *Memoir of Fleeming Jenkin*, 1912]. However, he later provided him with one containing a form of words for his father's eyes indicative of his having satisfactorily completed the class-work in engineering.

Louis wrote: 'I am still ashamed when I think of his shame in giving me that paper. He made no reproach in his speech, but his manner was the more eloquent; it told me plainly what dirty business we were on; and I went from his presence, with my certificate indeed in my possession, but with no answerable sense of triumph.' [R. L. Stevenson. *Memoir of Fleeming Jenkin*, 1912] There seems to have been no question of Louis graduating. This was the 'bitter beginning' of his great friendship with Jenkin of whom he wrote in 1885 'I never knew a better man' [Letter from Louis to Mrs Fleeming Jenkin, 12 June 1885. [In] R. L. Stevenson, *Works*. (Ed:

Sydney Colvin), London, Tusitala edition, 1923–24, XXXIII, 47] and on whom he bestowed to posterity a remarkable if not very comprehensive biography.

During the long summer vacations Louis gained practical experience of harbour and lighthouse engineering operations, particularly of pier construction at Anstruther and Wick in 1868. He was fascinated by the experience of sea diving but, in general, found the site work physically demanding and uncongenial. He wrote to his father from Anstruther on 2 July 1868: 'bring also my paint box. ... I am going to try the travellers and Jennies, and have made a sketch of them and begun the drawing. After that I'll do the staging.' The 'travellers' were timber gantries that moved along the pier and ahead of its temporary end, on rails supported on piles at each side of the pier. The *Jennies* were cranes, which moved backwards and forwards transversely on top of the travellers. They were used for lifting and lowering stones into position [see p. 32 for the travellers and jennies at Wick].

Tomorrow I will watch the masons at work at the pier foot and see how long they take to work that Fifeness stone you ask about: they get sixpence an hour; so that is the only datum required ... It is awful how slowly I draw and how ill: I am not nearly done with the travellers and have not thought of the Jennies yet. When I'm drawing I find out something I have not measured, or, having measured, have not noted, or, having noted, cannot find; and so I have to trudge to the pier again, ere I can go further with my noble design.

Of his experience at Anstruther Louis wrote:

What I gleaned, I am sure I do not know; but indeed I had already my own private determination to be an author; I loved the art of words and the appearances of life; and travellers and headers, and rubble, and polished ashlar [squared masonry], and pierres perdues [rubble stone], and even the thrilling question of string course [of masonry set out by string line], interested me only (if they interested me at all) as properties of some possible romance or as words to add to my vocabulary ... though I haunted the breakwater by day, and even loved the place for the sake of the sunshine, the thrilling sea-side air, the wash of waves on the sea-face, the green glimmer of the divers helmets far below, and the musical chinking of the masons, my one genuine pre-occupation lay elsewhere, and my only industry was in the hours when I was not on duty.

Then northwards to Wick:

Into the bay of Wick stretched the dark length of the unfinished breakwater, in its cage of open staging; the travellers (like frames of churches) over-plumbing all; and away at the extreme end, the divers toiling unseen on the foundation. On a platform of loose planks, the assistants turned their air mills; a stone might be swinging between wind and water; underneath the swell ran gayly; and from time to time a mailed dragon with a window glass snout came dripping up

the ladder ... To go down in the dress, that was my absorbing fancy; and with the countenance of a certain handsome scamp of a diver, Bob Bain by name, I gratified the whim ... Some twenty rounds below the platform, twilight fell. Looking up I saw a low green heaven mottled with vanishing bells of white; looking around, except for the weedy spokes and shaft of the ladder, nothing but a green gloaming.

Thirty rounds lower [at a depth of about 30 ft], I stepped off on the pierres perdues of the foundation; a dumb helmeted figure took me by the hand, and made a gesture (as I read it) of encouragement; and looking in at the creature's window, I beheld the face of Bain ... how a man's weight, so far from being an encumbrance, is the very ground of his agility, was the chief lesson of my submarine experience ... As I began to go forward with the hand of my estranged companion, a world of tumbled stones was visible, pillared with the weedy uprights of the staging: overhead, a flat roof of green: a little in front, the sea-wall, like an unfinished rampart.

And presently, in our upward progress, Bob motioned me to leap upon a stone ... Now the block stood six feet high; it would have been quite a leap to me unencumbered; with the breast and back weights, and the twenty pounds upon each foot, and the staggering load of the helmet, the thing was out of reason. I laughed aloud in my tomb; and to prove to Bob how far he was astray, I gave a little impulse from my toes. Up I soared like a bird, my companion soaring at my side. As high as to the stone and then higher, I pursued my impotent and empty flight. Even when the strong arm of Bob had checked my shoulders, my heels continued their ascent; so that I blew out sideways like an autumn leaf, and must be hauled in hand over hand, as sailors haul in the slack of a sail, and propped upon my feet again like an intoxicated sparrow ... Bain brought me back to the ladder and signed me to mount ... Of a sudden, my ascending head passed into the trough of a swell. Out of the green I shot at once into a glory of rosy, almost sanguine light—the multitudinous seas incarnadined, the heaven above a vault of crimson. And then the glory faded into the hard, ugly daylight of a Caithness autumn, with a low sky, a gray sea, and a whistling wind.

Diving was one of the best things I got from my education as an engineer: of which however, as a way of life, I wish to speak with sympathy. It takes a man into the open air; it keeps him hanging about harbor-sides, which is the richest form of idling; it carries him to wide islands; it give him a taste of the genial dangers of the sea; it supplies him with dexterities to exercise; it makes demands upon his ingenuity; it will go far to cure him of any taste (if ever he had one) for the miserable life of cities. And when it has done so, it carries him back and shuts him in an office! From the roaring skerry and the wet thwart of the tossing boat, he passes to the stool and desk; and with a memory full of ships, and seas, and perilous headlands, and the shining pharos, he must apply his long-sighted eyes to the petty niceties of drawing, or measure his

inaccurate mind with several pages of consecutive figures. He is a wise youth, to be sure, who can balance one part of genuine life against two parts of drudgery between four walls, and for the sake of the one, manfully accept the other. [R. L. Stevenson. 'The Education of an Engineer: More Random Memories.' *Scribner's Magazine*, November 1888, IV, 636-640].

In a letter to his mother on 20-21 September 1868, Louis wrote:

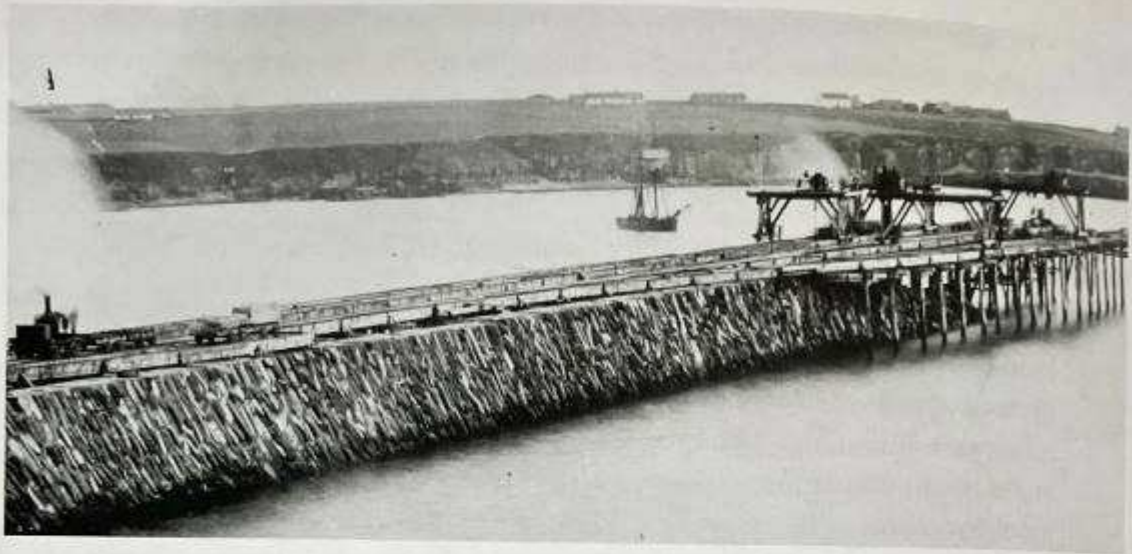
I was awakened by Mrs S. at the door [of the New Harbour Hotel, Pultneytown—now a Customs office]. There's a ship ashore at Shaltigoe! I got up, dressed and went out. The mizzled sky and rain blinded you ... Some of the waves were 20 feet high. The spray rose 80 feet at the new pier ... The thunder at the wall when it first struck—the rush along ever growing higher—the great jet of snow-white spray some 40 feet above you—and the 'noise of many waters', the roar, the hiss, the 'shrieking' amongst the shingle as it fell head over heels at your feet. I watched if it threw the big stones at the wall; but it never moved them.

[next day] The end of the [breakwater] work displays gaps, cairns of ten ton blocks, stones torn from their places and turned right round. The damage above water is comparatively little: what there may be below, 'ne sait pas encore'. The roadway is torn away, cross-heads broken, planks tossed here and there, planks gnawn and mumbled as if a starved bear had been trying to eat them, planks with spales lifted from them as if they had been dressed with a ragged plane, one pile swaying to and fro clear of the bottom, the rails in one place sunk a foot at least. This was not a great storm, the waves were light and short. Yet when we are [were] standing at the office, I felt the ground beneath me quail as a huge roller thundered on the work at the last year's cross-wall ...

[To] appreciate a storm at Wick requires a little of the artistic temperament which Mr.T.S.C.E. [Thomas Stevenson, Civil Engineer] possesses ... I can't look at it practically however: that will come I suppose like gray hair or coffin nails ... Our pole is snapped: a fortnight's work and the loss of the Norge schooner all for nothing!—except experience and dirty clothes.

[R. L. Stevenson. *Letters of ...* (Eds: Bradford A. Booth and Ernest Mehew), Newhaven and London, 1995, I, 156-158].

[Stevenson acted as a trainee engineer at Wick for 40 days from 28 August 1868 when the breakwater had reached about 70 per cent of its planned length or about 320m. from the shore. This was the maximum length actually achieved as from October 1868 heavy seas destroyed lengths of breakwater on at least four occasions leading to its shortening and eventual abandonment in 1877. He dubbed the breakwater, 'the chief disaster of my father's life ... the sea proved too strong for man's arts: and after expedients hitherto unthought of and on a scale hyper-cyclopean, the work must be destroyed, and now stands a ruin in that bleak, Godforsaken bay' (5) (13)].



*Wick Breakwater c. 1865. Note the 'travellers and jennies'
[the travelling cranes above the timber staging] being supplied with
stone by railway from the local South Head Quarry. © The Wick Society (2, 101)*

In a letter to his cousin Bob Stevenson, Louis paints an indelible picture of the mail coach journey from Wick, by night, to the most northerly railway terminus then at Golspie (about 50 miles to the south). [The railway did not reach Wick until 1874].



Mail coach at Wick in 1874 as familiar to Louis. © The Wick Society (2, 103)

The Wick Mail then, my dear fellow, is the last Mail Coach within Great Britain, whence there comes a romantic interest that few could understand. To me, on whose imagination positively nothing took so strong a hold as the Dick Turpins and Claude Duvals of last century, a Mail was an object of religious awe. I pictured the long dark highways, the guard's blunderbuss, the passengers with three-cornered hats above a mummerly of great-coat and cravat; and the sudden 'Stand and deliver!'—the stop, the glimmer of the coach lamp upon the horseman—Ah! we shall never get back to Wick.

All round that northern capital of stink and storm there stretches a succession of flat and dreary moors absolutely treeless, with the exception of above a hundred bour-trees [elders] beside Wick, and a stunted plantation at Stirkoke, for the distance of nearly twenty miles south. When we left to cross this tract, it was cloudy and dark. A very cold and pertinacious wind blew with unchecked violence, across these moorlands. I was sick sleepy [?], and drawing my cloak over my face set myself to doze. Mine was the box-seat, desirable for the apron and the company of the coachman, a person in this instance enveloped in that holy and tender interest that hangs about the 'Last of the Mohicans' or the 'Derniers Bretons'.

And as this example of the loquacious genus coachman was more than ordinarily loquacious I put down my hood again and talked with him. He had a philosophy of his own, I found, and a philosophy eminently suited to the needs of his position. The most fundamental and original doctrine of this, was as to what constitutes a gentleman. It was in speaking of Lockyer of Wenbury that I found it out. This man is an audacious quack and charlatan, destined for aught, I know, to be the Cagliostro [Italian charlatan] of the British Revolution; and, as such, Mr Lockyer is no favourite of mine: I hate quacks, not personally (for they are not men of imagination like ourselves?) but because of their influence; so I was rather struck on hearing the following. 'Well sir', said the coachman, 'Mr Lockyer has always shown himself a perfect gentleman to me, sir—his hand as open as you'll see, sir!' In other words, half-a-crown to the coachman!

As the pleasures of such philosophical talk rather diminished and the slumber increased, I buried my face again. The coach swayed to and fro. The wind battled and roared about us. I observed the difference in sounds—the rhythmic and regular beat of the hoofs as the horses cantered up some incline, and the ringing, merry, irregular clatter as they slung forward, at a merry trot, along the level.

First stage: Lybster. A Roman catholic priest travelling within, knowing that I was delicate, made me take his seat inside for the next stage. I dozed. When I woke, the moon was shining brightly. We were off the moors and up among the high grounds near the Ord of Caithness. I remember seeing a curious thing: the moon shone on the ocean, and on a river swollen to a great pool and between stretched a great black mass of rock: I wondered dimly how the river got out

and then to doze again. When next I wake, we have passed the low church of Berridale, standing sentinel on the heathery plateau northward of the valley, and are descending the steep road past the Manse: I think it was about one: the moon was frosty but gloriously clear.

In another minute—

Second stage: Berridale. And of all lovely places, one of the loveliest. Two rivers run from the inner hills, at the bottom of two deep, Killiecrankie-like gorges, to meet in a narrow bare valley close to the grey North Ocean. The high Peninsula between and the banks, on either hand until they meet, are thickly wooded—birch and fir. On one side is the bleak plateau with the lonesome little church, on the other the bleaker, wilder mountain of the Ord. When I and the priest had lit our pipes, we crossed the streams, now speckled with the moonlight that filtered through the trees, and walked to the top of the Ord. There the coach overtook us and away we went for a stage, over great, bleak mountains, with here and there a hanging wood of silver birches and here and there a long look of the moonlit sea, the white ribbon of the road marked far in front by the newly erected telegraph posts. We were all broad awake with our walk, and made very merry outside, proffering 'fills' of tobacco and pinches of snuff and dipping surreptitiously into aristocratic flasks and plebeian pint bottles.

Third stage: Helmsdale. Round a great promontory with the gleaming sea far away in front, and rattling through some sleeping streets that shone strangely white in the moonlight, and then we pull up beside the Helmsdale posting-house, with a great mountain valley behind. Here I went in to get a glass of whiskey and water. A very broad, dark commercial said: 'Ha! do you remember me? Anstruther?' I had met him five years before in the Anstruther commercial room, when my father was conversing with an infidel and put me out of the room to be away from contamination; whereupon I listened outside and heard the man say he had not sinned for seven years, and declare that he was better than his maker. I did not remember him; nor did he my face, only my voice. He insisted on standing me the whiskey "for auld lang syne"; and he being a bagman, it was useless to refuse.

Then away again. The coachman very communicative at this stage, telling us about the winter before, when the mails had to be carried through on horseback and how they left one of their number sticking in the snow, bag and all I suppose. The country here was softer; low, wooded hills running along beside the shore and all inexpressibly delightful to me after my six months of Wick barrenness and storm.

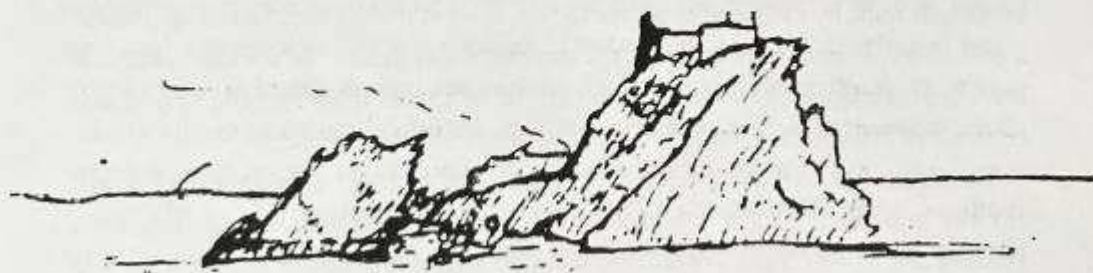
Fourth stage: name unknown. O sweet little spot, how often I have longed to be back to you! A lone farm-house on the sea-shore, shut in on three sides by the same, low, wooded hills. Men were waiting for us by the roadside, with the horses—sleepy, yawning men. What a peaceful place it was! Everything

steeped in the moonlight, and the gentle splash of the waves coming to us from the beach. On again. Through Brora, where we stopped at the Post-Office and exchanged letter-bags through a practicable window-pane, as they say in stage directions. Then on again. Near Golspie now, and breakfast, and the roaring railway. Passed Dunrobin, the dew-steeped, tree-dotted park, the princely cluster of its towers, rising from bosky plantations and standing out against the moon-shimmering sea—all this sylvan and idyllic beauty so sweet and new to me! Then the Golspie Inn, and breakfast and another pipe, as the morning dawned, standing in the verandah. And then round to the station to fall asleep in the train ...

[R. L. Stevenson. *Letters of ...* (Eds: Bradford A. Booth and Ernest Meheew), Newhaven and London, 1995, I, 169–172].

In June 1869 Louis accompanied his father on a voyage of inspection of lighthouses in Orkney and Shetland in the lighthouse steamer and provided his mother with a detailed account of his 'sore journeying and perilous peregrination'. For example:

... we sighted North Unst Lighthouse, the most northerly dwelling house in Her Majesty's dominion. The mainland rises higher, with great seams and landslips; and from the norwestern corner runs out a string of shelving ledges, with a streak of green and purple seaweed and a boil of white foam about their feet. The lighthouse stands on the highest—190 feet above the sea; ... the reefs looked somewhat thus ... [see sketch]



Louis's sketch of Muckle Flugga in 1869 [R. L. Stevenson. Letters of ... (Eds: Bradford A. Booth and Ernest Meheew), 1995. I. 181]. (2, 85)

We were pulled into the creek shown in the picture between the lighthouse and the other rock, down the centre of which runs a line of reef ... This is very narrow, little broader than a knife edge; but its ridge has been cut into stone steps and laid with iron grating and railed with an iron railing. It was here that we landed, making a leap between the swells at a rusted ladder laid slant-wise against the raking side [of] the ridge. Before us a flight of stone steps led up the 200 feet to the lighthouse in its high yard-walls across whose foot the sea had cast a boulder weighing 20 tons. On one side is a slippery face of clear sound

rock and on the other a chaos of pendulous boulder and rotten stone. On either side there was no vegetation save tufts of sea-pink in the crevices and a little white lichen on the lee faces.

[R. L. Stevenson. *Letters of ...* (Eds: Bradford A. Booth and Ernest Meheew), Newhaven and London, 1995, 8, 181].

During his summer vacation of 1870 Louis spent three weeks on the isle of Erraid [off Mull], from which he visited Dhu Heartach Lighthouse then under construction 15 miles to the south-west. Two years later, although then pursuing his law classes at University, he managed in the summer to produce a lively account of the project:

Even before the work was sanctioned, he wrote, Dhu Heartach had given the engineers a taste of its difficulties. Although the weather was fine, Messrs Stevenson failed to effect a landing and had to send in their preliminary report based merely upon what they could see from the deck of the vessel. But even this had not prepared them for the continual difficulty and danger which accompanied every landing from the beginning to the end of the work. Favoured by the smooth egg-shaped outline of the rock, which is about [130] feet broad, [240] feet long and 35 feet above high water at its summit, the swell breaks at the one end, runs cumulating round either side, and meets and breaks again at the opposite end, so that the whole rock is girdled with broken water. There is no sheltered bight. If there be anything to aggravate the swell, and it is wonderful what a little thing it takes to excite these giant-waters, landing becomes impossible ... The probability is that the very height of Dhu Heartach rock, by causing the waves to rise, is what makes them so dangerous at a considerable elevation; in short the destructive character of a wave as regards level depends upon the relation between the height of the wave, the height and contour of the obstacle and the depth of water in which it acts.

The first object of the Messrs Stevenson was to erect a temporary barrack for the residence of the workmen ... it was decided that the structure—a framework 35 feet high, supporting a plated cylinder or drum 20 feet high and divided into two stories—should consist entirely of malleable iron [see figure] ... the shore station was placed on Isle Earraid. On the twenty-fifth of June ... they first took possession of the rock and disturbed the seals, who had been its former undisputed tenants. ...

The work during this first season was much interrupted. Even when a landing was effected, the sea rose so suddenly and there was such a want of appliances upon the Rock itself, that the men had sometimes hard [had?] enough ado to get off again. ... The season which began so late closed finally on the third of September; and the first tier of the barrack framework was left unfinished.

All the winter of 1867–68, a band of resident workmen were carrying on the shore station with its bothies, cottages, quarry and the workyard where every stone was to be cut, dressed, fitted and numbered before being sent out to

the rock to be finally built into the tower; and on the fourteenth of April, the *Dhu Heartach steamer* came back to her moorings in Earraid Sound. The result proved that she was too early; for there was no landing at all in April; only two in May, giving between them a grand total of two hours and a half upon the rock; and only two once again in June. In July there were 13, in August ten, in September 11: in all, 38 landings in five months. ...

On the twentieth of August, the malleable iron barrack was so far advanced and the weather gave such promise of continuing fine, that Mr Alan Brebner C.E. (of Edinburgh) and 13 workmen landed on the rock and took up their abode in the drum ... A sudden gale however sprung up and they could not be communicated with till the 26th [August 1868] during the greater part of which time the sea broke so heavily over the rock as to prevent all work and during the height of the storm the spray rose far above the barrack and the sea struck very heavily on the flooring of the lower compartment which is 35 feet above the rock and 56 feet above high water mark.

The third season, that of 1869, saw the work properly commenced. The barrack had come scatheless through the winter, and the master-builder Mr Goodwillie with between 20 and 30 workmen took up his abode there, on the twenty-sixth of April. On Isle Earraid, there was a good quarry of granite, two rows of sheds, two travelling cranes, railways to carry the stones, a stage on which, course after course, the lighthouse was put experimentally together and then taken down again to be sent piece-meal out to the rock, a pier for the lighters [stone carrying boats], and a look out place furnished with a powerful telescope by which it could be observed whether the weather was clear [and] how high the sea was running on *Dhu Heartach* and so judge whether it were worthwhile to steam out on the chance of landing. In a word, there was a stirring village of some [50] souls, on this island which, four years before, had been tenanted by one fisherman's family and a herd of sheep.

The life in this little community was highly characteristic. On Sundays only, the continual clink of tools from quarry and workyard came to an end, perfect quiet then reigned throughout the settlement, and you saw workmen leisurely smoking their pipes about the green enclosure, and they and their wives wearing their Sunday clothes (from association of ideas, I fancy) just as if they were going to take their accustomed seats in the crowded church at home. As for the services at Earraid, they were held in one of the wooden bothies, the audience perched about the double tier of box beds or gathered round the table. Mr Brebner [The Engineer] read a sermon and the eloquent prayer which was written specially for the Scottish Lighthouse service, and a voluntary band and precentor led the psalms. Occasionally, a regular minister came to the station, and then worship was held in the joiner's shop. ...

In fine weather, before the sun had risen behind Ben-More, the *Dhu Heartach* steamed out of the bay towing a couple of heavy, strong-built lighters

laden with the dressed and numbered stones. It was no easy or pleasant duty to be steersman in these lighters, for what with the deck-cargo and the long heavy swell, they rolled so violently that few sailors were able to stand it. Dhu Heartach itself on some such calm, warm summer day presented a strange spectacle. This small black rock, almost out of sight of land in the fretful, easily-irritated sea, was a centre of indefatigable energy.

The whole small space was occupied by men coming and going between the lighters or the barrack and the slowly-lengthening tower. A steam winch and inclined plane raised the stones from the water's edge to the foot of the building; and it was a matter of no little address and nicety, to whip one of these great two-ton blocks out of the lighter, [see sketch] as it knocked about and rolled gunwale-under in the swell, and bring it safely up to the tower, without breaking it or chipping off some corner that would spoil the joint. Then, there would come the dinner horn; and the noise was incontinently quieted, there was no more puffing of the steam engine or clink of the mallets on the building; the men sat scattered in groups over their junk [salt meat] and potatoes and beer. ...

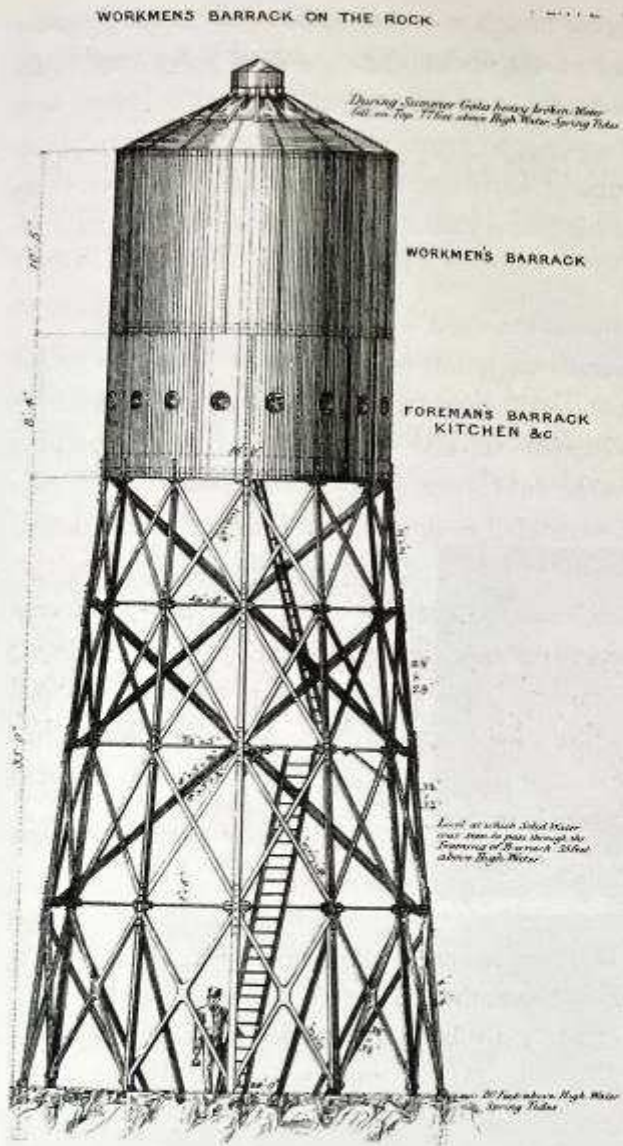
By the end of this season, the tower had reached the height of eight feet, four inches... But the heaviest end of the work was now over. In the fourth season, 1870, there were 62 landing days, and the white tower soon began to top its older brother the iron barrack. By the end of that season, it was 48 feet high, the last stone was laid next summer, and, during the present summer, the lantern and internal fittings have also been brought to completion. Before the end of 1872, the light will have been exhibited. For the tower ... Messrs Stevenson adopted:

the form of a parabolic frustum, to a hundred and seven and a half feet high, 36 feet in diameter at the base and 16 feet at the top all built of granite ... The entire weight of masonry is 3,115 tons. ... The light will be fixed dioptric with a range of 18 miles in addition to which there is machinery which rings during fogs a hundredweight bell.

Anticipating possible future discomforts arising from the difficulty of landing supplies, he concludes:

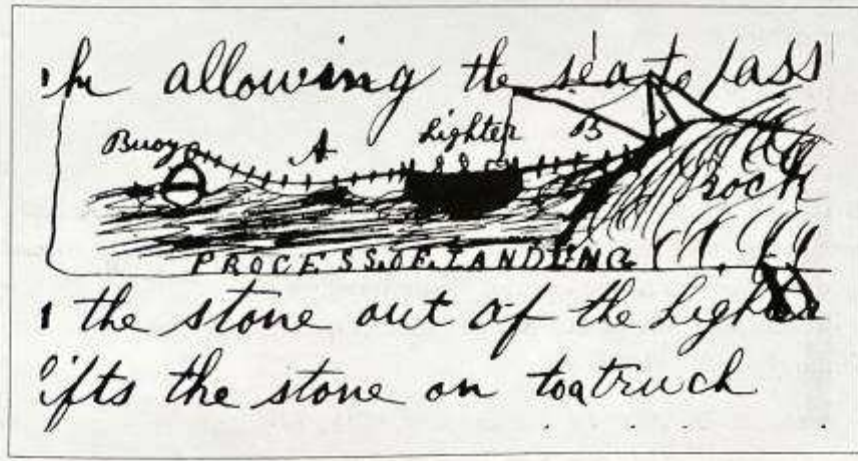
Shortly before the light was first exhibited, [at nearby Skerryvore Lighthouse] ... a long track of storms extending over seven weeks prevented the tender from getting near the reef; and before the weather had moderated, the stock of tobacco in the tower was quite exhausted. On the morning of this catastrophe, the [workmen] ceremoniously broke their pipes and put up a chalk inscription over the mantle shelf in the kitchen: 'Such-and-such a date, Tobacco done—Pipes Broken.' Let us hope that no such 'memor querela' may ever be read over the chimney of Dhu Heartach.

[R. L. Stevenson. *The New Lighthouse on the Dhu Heartach Rock, Argyllshire* (Ed: Roger G. Swearingen), St Helena, California, 1995, 1–21].



Left: Workmen's barrack Dhu Heartach Rock [T. Stevenson] (2, 106)

Below: Sketch of lifting stones from a lighter by derrick to a truck at the bottom of the inclined plane at Dhu Heartach in 1870 (2, 117, by David Alan (Louis's 16 year old cousin)



It is doubtful whether Louis's delicate health would have allowed him to become a successful engineer even if he had had the inclination and had persevered with his engineering education. Fortunately for posterity he gave reign to what was undoubtedly his greater talent, but it was not to prove a decision which was to bring him complete peace of mind. At the age of 43, in the last year of his life, he wrote to W. H. Low in a fit of depression, that his literary achievements had been inadequate for:

the top flower of a man's life ... Small is the word; it is a small age and I am of it. I could have wished to be otherwise busy in this world. I ought to have been able to build lighthouses and write 'David Balfours' too. Hinc illae lacrymae [hence these tears]. [R. L. Stevenson. *Letters of...* (Eds: Bradford A. Booth and Ernest Mehew). Newhaven and London, 1995, 8, 235]



*Far left: David Alan Stevenson.
(2, 151)*

*Left: [David] Alan Stevenson.
[Family source]*

*Below: Charles Alexander
Stevenson at D. and C. Stevenson's
office, 84 George Street, Edinburgh,
c. 1920. (2, 170)*



DAVID ALAN STEVENSON

1854–1938

CHARLES ALEXANDER STEVENSON

1855–1950

(DAVID) ALAN STEVENSON

1891–1971

David Alan Stevenson (1854–1938), civil engineer, and his business partner, Charles Alexander Stevenson (1855–1950), were sons of David Stevenson and born in Edinburgh (at 8 Forth Street and 20 Royal Terrace respectively) on 21 July 1854 and 23 December 1855. They were both educated at Scott's Preparatory School, Edinburgh Academy, and Edinburgh University. David (usually known as David A. Stevenson) graduated BSc in 1875 and Charles likewise in 1877. Robert Louis Stevenson (1850–1894) was their cousin. Charles's son, (David) Alan Stevenson (1891–1971), civil engineer, usually known as D. Alan Stevenson, was born in Edinburgh at 9 Manor Place on 7 February 1891. Educated at Edinburgh Academy and Edinburgh University, he spent most of his professional life working with his father and uncle.

Early work

David and Charles Stevenson began their rigorous engineering training in the offices of D. and T. Stevenson on the second floor of 84 George Street, Edinburgh, during school vacations in 1868 and 1869, and entered into their formal three-year apprenticeships in 1875 and 1877. From 1875 to 1880 the firm was engaged on lighthouses at the Isle of Man and Holy Island, Arran, and on harbour work at Port Seton, Boddam, St Monance, Burnmouth, Gourrock, Findochtie, Anstruther, and Broadford in Skye. Other work included preparations for deepening the Clyde from Port Glasgow seawards to 18 feet at low water for the Clyde Lighthouses Trust, which, in addition to lighthouse responsibilities, had a navigational remit for this length of river. David was an able technical writer and read his first paper 'Dhu Heartach Lighthouse' to a meeting at the Institution of Civil Engineers in 1876. This paper, based on the firm's reports and his teenage visits to the isolated rock during the lighthouse's construction, was awarded an Institution Manby premium prize. In 1878 David and the firm's most able senior assistant for many years, Alan Brebner (1826–1890), were taken into the partnership; Charles followed in 1886.

During the 1880s the firm undertook sewerage, harbour works, inspection of water-supply schemes for the Board of Supervision, and maintenance of North Esk Reservoir in the Pentland Hills. It was involved in the preparation of a major Forth and Clyde ship canal scheme that was level between sea-locks via Loch Lomond

and Loch Long, which was never implemented, and it opposed the proposed Forth Bridge, to ensure an adequate navigational height, and the original Manchester ship canal scheme. For the Northern Lighthouse Board, the Stevensons introduced Courtenay whistling and Pintsch gaslight buoys. The latter were developed by Charles in 1880–81 and were integral to important experiments on the relative merits of oil, gas, and electricity as illuminants.

Other work for the board included the design and construction of the Ailsa Craig Lighthouse and foghorns, new lights in Orkney and Shetland, the North Carr lightship, and the introduction of electric light at the Isle of May Lighthouse. In 1884, with his brother David's retirement through ill health, Thomas Stevenson had become the board's sole engineer, but when his health began to fail in 1885 his nephew the younger David was appointed to act jointly with him. He was sole Engineer from Thomas's death in 1887 until 1938.

D. AND C. STEVENSON

1890–1936

In 1890 the firm became D. and C. Stevenson and until the First World War it was involved with navigational improvements of the Luncarty, Forth, and Manchester ship canals, the Forth and Clyde canal scheme, Oban sewerage, the branch railway from Longniddry to Gullane, deepening the lower Clyde to 27 feet, and numerous harbours in Scotland. Work for the Northern Lighthouse Board included lighthouse stations at Fair Isle, Rattray Head, Sule Skerry, Stroma, Scarinish, Noup Head, Flannan Island, Tiumpan Head, Bass Rock, Barns Ness, Killantringan, Hyskeir, Elie-Ness, Firths Voe, Neist Point, Rubha Reidh, Crammag Head and Maughold Head on the Isle of Man, and several lightships. Charles designed and implemented in 1910 at Platte Fougère, Guernsey, a remotely controlled and electrically operated acetylene light and foghorn installation—a precursor of the later lighthouse control system.

Other work included the installation of 'group flashing lights' at the Mull of Kintyre Lighthouse and the provision of many minor lights. The introduction of Sir James Chance's incandescent burners to Scottish lighthouses in 1903 and the wireless activation of equipment in 1914 were innovations of considerable significance by the Stevensons that became widely adopted in the lighthouse service. Except when specifically requested, David restricted his horizon to the Northern Lighthouse Service while Charles dealt with the firm's other work, but they collaborated on reports. This combination of talents, with Charles concentrating on equipment innovation and river engineering and his brother on the Board's work, worked well, and ensured

the success of the firm until its dissolution in 1936. The brothers acted jointly as Engineers to the Clyde Lighthouses Trust and the Fishery Board of Scotland. In 1875 the most powerful light on the Scottish coast was of 44,500 candlepower. By 1901 there were several lights of over 100,000 candlepower, and the Isle of May electric light was of 3,000,000 candlepower. This increase in power was achieved by means of long focal distance apparatus that the Stevensons designed together, and the introduction of Charles's equiangular prisms which condensed the light into a narrower and more brilliant beam than previously. Before the turn of the nineteenth-century, David and Charles Stevenson had become leading authorities in their field, and during their partnership they acted as consulting engineers to several colonial and foreign lighthouse authorities.

During the same period Charles Stevenson pioneered the development of wireless communication and corresponded with Oliver Heaviside, Sydney Evershed, and other experimenters. In 1893–94 he conducted experiments in telephonic communication by electrical induction using coils, in which he successfully received speech over a distance of about half a mile at Murrayfield, Edinburgh. These experiments were carried out with a view to establishing a communication between Muckle Flugga Lighthouse and the Shetland mainland, but the need for this was questionable and it was never implemented. Charles is said to have anticipated Marconi, Heaviside, Preece and others in wireless transmission of speech. The apparatus did, however, have the drawback of being inconvenient to use because of the large diameter of the coil layout required (200 yards to transmit over half a mile) and its limited range. Charles Stevenson also invented the 'leader cable' for guiding vessels by means of an electric submarine cable laid on the ocean bed, a system eventually developed and installed at several large ports in Europe and the USA. It was used during the First World War in the North Sea off Harwich to guide vessels through minefields, and both these inventions formed the subject of papers read to the Royal Society of Edinburgh in 1894 and 1893. He also invented the automatic acetylene fog-gun signal.

Among Charles Stevenson's later innovations, jointly with his son, was the 'talking beacon' for use by ships in fog, which enabled the position of a ship to be plotted on board from synchronized radio and sound signals through the air. The radio signal provided the direction of the beacon and the distance from it was obtained by measuring the sound travel time from hearing a fog-signal detonation at the beacon on the ship's radio to its time of arrival at the ship through the air. The equivalent distance was stated on the radio in miles and cables at every cable (one-tenth of a nautical mile). This precursor of modern radar and satellite navigation was developed for the Clyde Lighthouses Trust and installed at the Cumbrae and Cloch lighthouses in 1929 and 1939. In 1931 this invention earned father and son the Thomas Gray award of the Royal Society of Arts.

In 1914, after having graduated with a BSc degree at Edinburgh University and serving his apprenticeship under his father, D. Alan Stevenson became an assistant in the firm. In 1919 he was taken into partnership. By the 1920s the period of great development of harbours, lighthouses, and navigational river deepenings in Britain had passed, and the nation was in the throes of economic recession. Nevertheless, the firm still kept busy in a smaller way on such works as further deepening the lower Clyde, sewerage and water supply projects and, more particularly, on the maintenance of lighthouse stations and modernization of equipment.

In 1926–27, for the government of India, Alan Stevenson inspected more than 100 lighthouses and advised on the organization of a centralized lighthouse service. In the 1930s, then the most physically active member of the firm, he skilfully superintended the deepening of the Clyde from Port Glasgow westwards, which enabled the *Queen Mary* to go to sea in 1936. This year turned out to be a fateful one for the family firm. According to Charles's granddaughter Jean Leslie, Alan Stevenson had grown impatient with the uncertainty of obtaining the post of engineer to the Northern Lighthouse Board still held by David Stevenson, then aged 81. This led to a difference that resulted in David Stevenson's withdrawal from D. and C. Stevenson, thus ending the firm's long-standing association with the board.

The D. and C. Stevenson firm was reformed in 1936, as A. and C. Stevenson, at 90a George Street, Edinburgh. As the NLB work continued with David Stevenson who was not now a partner, the new firm's workload was much reduced, relying principally on the family commission as joint Engineers to the Clyde Lighthouses Trust. Four years later Charles Stevenson retired, after which Alan Stevenson continued to act solely as the Trust's Engineer. His retirement in 1952 marked the end of nearly a century and a half of continuous service by Stevenson engineers to the Trust. In 1945 he read what is now a historically valuable paper on the engineering work of the Trust to the Institution of Engineers and Shipbuilders in Scotland.

Learned societies, personal life, outside activities

In 1886 and 1891 respectively, David and Charles Stevenson became members of the Institution of Civil Engineers, at which in 1887 David Stevenson read a paper on the Ailsa Craig Lighthouse station, winning him a Telford premium prize. He also addressed the Institution of Mechanical Engineers on the installation of electric light at the Isle of May. The following year he and Charles Stevenson revised, updated, and published the third and most comprehensive edition of their father's influential textbook—*Canal and River Engineering*. From 1894 to 1897 David Stevenson was an extramural examiner at the University of Edinburgh. He also gave evidence before royal commissions, parliamentary committees, and in important legal cases.

Charles Stevenson became a regular correspondent to *Nature* and other scientific periodicals on such diverse matters as the 1880 earthquake in Scotland, seismography,

river discharge formulae, wind velocity and dioptric lenses. In 1887 and 1888 he read papers on dredging the Clyde and on a dipping or fog apparatus for electric light in lighthouses to the Institution of Mechanical Engineers and the Institution of Civil Engineers. To the latter in 1894, he read a paper on his important innovation of equiangular prism refractors for brightening dioptric lights. David and Charles Stevenson were elected fellows of the Royal Society of Edinburgh in 1884 and 1886 respectively. They were also members of the Royal Scottish Society of Arts and the Highland and Agricultural Society. In 1893 Charles Stevenson became an associate member of the Institution of Electrical Engineers. In 1919 Alan Stevenson continued in the family tradition by being elected a fellow of the Royal Society of Edinburgh, and in 1925 a member of the Institution of Civil Engineers.

Charles Stevenson married, on 19 January 1889, Margaret (1863–1945), daughter of Lieutenant-General John P. Sherriff. On 21 January 1892 David Stevenson married Dorothy Anne Roberts (c.1862–1945). The brothers' outside interests included golf, archery with the Royal Company of Archers, and skating with the Edinburgh Skating Club (for whom Charles Stevenson wrote the article 'Statics and Dynamics of Skating' in *Nature* [20 January 1881], which is also believed to have been separately printed as a pamphlet). The second edition of a booklet entitled *Skating Diagrams: Drawn by Charles A. Stevenson, C.E.* was published in 1881 at the expense of the Glasgow Skating Club. Later, Alan Stevenson also took up these interests and became the last secretary of the Edinburgh Skating Club. He was also a fellow of the Royal Scottish Geographical Society and served as its honorary treasurer. He married Jessie Laura Margaret MacLellan (1897–1975) on 5 June 1923.

David Stevenson served as Engineer to the Northern Lighthouse Board until his retirement on 31 March 1938, which ended 151 years of family service. He died on 11 April 1938 at his home, Troqueer, Kingsknowe, Edinburgh, and was buried in the Dean cemetery, Edinburgh. Charles Stevenson, the most inventive member of the family, with the possible exception of Thomas Stevenson, was described by his Royal Society of Edinburgh biographer as: 'a man of great intellectual acumen, but for work of this sort [engineering] he had a very special natural aptitude—a sort of instinctive grasp of how nature would work in the waves and winds and tides. His personal character had a great charm. Kindliness, gentleness and tolerance are characteristics that come to one's mind in recalling him, and permeating them all there was a natural unaffected simplicity and absence of sophistication.' (Johnstone)

He died on 9 May 1950 at his home, 29 Douglas Crescent, Edinburgh, and was also buried in the Dean Cemetery.

By the time of his retirement in 1952 Alan Stevenson had become increasingly involved in research for various historical pursuits, an interest which can be traced back to his article 'Early Scottish Lighthouses' in *Chambers Journal* (1917). He

published his first full-length book in 1949—an account of Robert Stevenson's *English Lighthouse Tours, 1801, 1813, 1818*. This was followed by his definitive work, *The Triangular Stamps of Cape of Good Hope* (1950), for which he was awarded the Crawford medal of the Royal Philatelic Society and, his authoritative *The World's Lighthouses Before 1820* (1959).

Alan Stevenson is now remembered not so much for his engineering achievements but as a diligent custodian of the family's business records from about 1800, now at the National Library of Scotland (MS Acc. 10706), and as the nation's, if not the world's, foremost lighthouse historian of his day. His detailed unpublished notes and articles relating to the life and work of his engineering forebears proved an invaluable source of information to his biographers (Mair, Leslie, and Paxton). It was said of Alan Stevenson by the general manager of the Northern Lighthouse Board that: 'His was a life dedicated to lighthouses; his interest in them never flagged and a visitor to his bedside during his last illness will always remember his keen desire to discuss the latest developments. We in the Lighthouse Services of the world have lost not only an acknowledged authority but a true and staunch friend.' (Robertson)

He died on 22 December 1971 at 25 Belgrave Crescent, Edinburgh, and was buried in the Dean Cemetery.

Conclusion

With Alan Stevenson's death the family dynasty of civil engineers came to an end. It had begun with the appointment of Thomas Smith as Engineer to the Northern Lighthouse Board in 1787 and spanned five generations and 165 years of professional practice.

The family's main contributions to society were the improvement of maritime safety, the facilitation of trade by means of the design and erection of more than 200 lighthouses, improving the illumination of many of the world's lighthouses, and navigational or drainage improvements to numerous British harbours and most major rivers from the Ouse northwards to the Dornoch Firth. The firm's private work played a major part, as can be gauged from the fact that at the height of its success in the third quarter of the nineteenth-century only about one-quarter of its profits were attributed to Northern Lighthouse Board work.

Seven of the Stevenson engineers had the remarkable distinction of being members of both the Institution of Civil Engineers (1828–1971) and fellows of the Royal Society of Edinburgh (1815–1971). Their innovative work was often at the frontiers of technology and practice, and collectively they produced more than 200 professional publications including several influential textbooks. Overall, it was an outstanding achievement for a small firm, and one that has earned the Stevensons a place among the nation's most notable civil engineering families. Robert Louis

Stevenson's eloquent family reminiscence of their beacons and towers around the coast forms a fitting finale:

*In the afternoon of time
A strenuous family dusted from its hands
The sand of granite, and beholding far
Along the sounding coast its pyramids
And tall memorials catch the dying sun,
Smiled well content,*

[*Poems, 'Underwoods', XXXVIII, c.1885*]

Sources

J. Leslie and R. Paxton, Bright Lights: the Stevenson Engineers, 1751–1971 (1999) · C. Mair, Star for Seamen: the Stevenson Family of Engineers (1978) · J. D. Gardner, Proceedings of the Royal Society of Edinburgh, 58 (1937–8), 280–82 · R. W. Johnstone, 'Charles Alexander Stevenson, BSc, MICE', Year Book of the Royal Society of Edinburgh (1950–51) · A. Robertson, International Lighthouse Authority Bulletin (April 1972) · C. Mair, David Angus: the Life and Adventures of a Victorian Railway Engineer (1989) · Private information (2004) [family] · d. cert. [David Alan Stevenson] · d. cert. [Charles Alexander Stevenson] · d. cert. [(David) Alan Stevenson]

Archives

NAS, Northern Lighthouse Board records · National Monument Record of Scotland, RCAHMS. · NLS, business records of Robert Stevenson and sons, civil engineers, MS Acc. 10706

Likenesses

Photograph, c.1920 (Charles Alexander Stevenson), repro. [in] Leslie and Paxton, Bright Lights: the Stevenson Engineers · Photograph, c.1932 ((David) Alan Stevenson), repro. [in] Leslie and Paxton, Bright Lights: the Stevenson Engineers · Photograph, repro. [in] Mair, Star for Seamen: the Stevenson Family of Engineers · Photograph, repro. [in] Leslie and Paxton, Bright Lights: the Stevenson Engineers · Photograph (Charles Alexander Stevenson), repro. [in] Mair, Craig, Star for Seamen: the Stevenson Family of Engineers · Photograph ((David) Alan Stevenson), repro. [in] Mair, Craig, Star for Seamen: the Stevenson Family of Engineers

Wealth at death

£160,444—(David) Alan Stevenson: confirmation, 1972, NAS, SC 70/1/2029/54–60.