

Part II

A new look at the creation of Bell Rock Lighthouse from little-known records

Comprising:

An introduction by the editor

Robert Stevenson's *Account of the Bell Rock Lighthouse* published in 1813

John Rennie's unpublished report of October 1809 to the Commissioners

Appendix A. John Rennie's letter of 12 March 1814 to Matthew Boulton regarding his and Stevenson's roles

Appendix B. Extract from Rennie's letter of 13 February 1807 to Stevenson specifying the curve of the base

AN INTRODUCTION BY THE EDITOR

The contents of the following little-known records complement my understanding of the relative contributions of John Rennie and Robert Stevenson to the creation of the Bell Rock Lighthouse set out in *Bright Lights: the Stevenson Engineers* (1999) (2, 35–37).

The first record is an *Account* of the lighthouse written in the year following its completion by Robert Stevenson which, now appropriately illustrated, mostly from his own later work, makes fascinating reading. His authoritative descriptions range from the medieval tolling bell which gave the rock its name, via shipwrecks in 1799 giving

impetus to early beacon attempts and his own proposals of 1800, to the as-built lighthouse and its erection, occupation and key participants. He acknowledges then, that to himself and Rennie 'was committed the execution of this great undertaking'.

This acknowledgement in 1812 is of interest in the context of the controversy which arose later between the Rennies and Stevensons as to whose forebear *designed and built* the lighthouse. Although Stevenson does not specify their relative contributions here, perhaps if he had the controversy would never have arisen, but fortunately for clarification in this context the Northern Lighthouse Board minutes confirm Rennie as 'Chief Engineer' and Stevenson as 'assistant engineer to execute the work under his superintendence' [NAS: NLC2/1/1]. It is also clear, mainly from evidence in the Rennie papers [as much of the relevant correspondence has been removed at some time from the Stevenson archive], that from 1806–10, by means of meetings, reports and considerable correspondence, they acted competently and in a friendly manner in the best tradition of the chief engineer/resident engineer relationship, both engaging in design and execution.

Stevenson himself does not seem to have claimed to have been the sole designer of the as-built lighthouse in any of his publications but, as he did not clarify Rennie's fundamental part in this, and as Rennie himself never managed to publish an account [although working on one in 1820 – he died in 1821], the merit for the lighthouse's design and construction became in time generally attributed to Stevenson. Rennie had become aware of how the situation in this respect was developing by 1814 when he wrote: 'I have no doubt the whole merit of the Bell Rock Lighthouse will, if it has not already been, [be] assumed by [Stevenson] ... The original plans were made by me and the work visited from time to time by me during its progress.' (11, Appendix A).

The second record, now published for the first time, is Rennie's key progress report of 1809 on the project. It is almost unknown because it was omitted by Stevenson from the appendix of reports in his otherwise largely definitive *magnum opus* on the lighthouse published in 1824 (3). This omission, and the fact that Rennie's contribution was largely ignored elsewhere in the book, supports Rennie's, and Clerk of Works David Logan's, belief that Stevenson was 'endeavouring to appropriate the whole merit' of the lighthouse undertaking. Its omission from the main reference work on the project undoubtedly deprived readers of the opportunity of appreciating Rennie in overall charge of operations when the masonry of the tower was above the height of the greatest danger of demolition by heavy seas, giving directions, and noting with satisfaction the beneficial effect of his tower profile against wave action. The omission also gave the false impression that Rennie never inspected the work after the building of the tower had barely started.

A comparison of the Stevenson and as-built designs (pages 96 and 102) indicate the considerable extent of Rennie's overall influence on the work as implemented.

His 'new plan' of cycloidal curves for a more slender as-built tower [Appendix B], a significant improvement on the shape adopted at Eddystone Lighthouse, sent from London in February 1807, enabled the detailed working drawings to be progressed under Stevenson's direction at Arbroath by draughtsman David Logan. These drawings, which included many Stevenson design elements in detail, were sent to Rennie for his approval from September 1807 onwards. As part of his overall direction Rennie also furnished holograph sketches of work to be carried out and, in one instance noticed [see page 77], rejected undovetailed masonry prepared under Stevenson's superintendence.

These above-mentioned actions, now confirmed from letters in the Rennie archive, contradict the contention of Robert Stevenson's sons, which misled many later students of this subject, including Robert Louis Stevenson who wrote in 1893 'that Rennie did not design [or] execute' the lighthouse 'and was not paid for it.' (*Records of a Family of Engineers ... 1912*, 94). Posterity was led to believe that Rennie's role was solely: 'advising their father in cases of emergency and as having suggested alterations of Stevenson design to which he did not acquiesce (1), that Stevenson alone was in complete control of the design, and that on no occasion did Rennie give instructions or directions.' (7, 301)

The merit for the most difficult part of the undertaking, its execution versus the sea by means of what were truly innovative expedients dictated by exceptionally difficult site circumstances, was undoubtedly due to Stevenson as the resident engineer. But, Rennie's contribution was a fundamental element in its sustainability, and without his masterly touch on this, the materials used, and his insistence on closer adherence to Smeaton's Eddystone Lighthouse practice, the lighthouse might have shared the fate of Stevenson's 40 feet high Carr Rock stone tower beacon (1813–17) 13 miles SSW of Bell Rock. Most of this tower was swept away by the sea in a storm soon after its completion in 1817, to be replaced, in 1821, by the present six-pillar cast iron, beacon founded on the surviving courses. (3, 56)

This review concludes that, whilst recognising Robert Stevenson's exceptional contribution to the creation of this two-centuries-old marvel of lighthouse engineering, no one person was solely responsible for its design and execution. In engineering terms, the as-built lighthouse was essentially a masterpiece of state-of-the-art practice, modelled on Smeaton's hard-won experience at Eddystone. It was designed and executed jointly in the capacities of their Northern Lighthouse Board appointments by Rennie and Stevenson and their dedicated and competent workforce, headed by those named in Stevenson's 1812 account (page 69), not least, the Logans, and the ingenious Francis Watt.

Roland Paxton

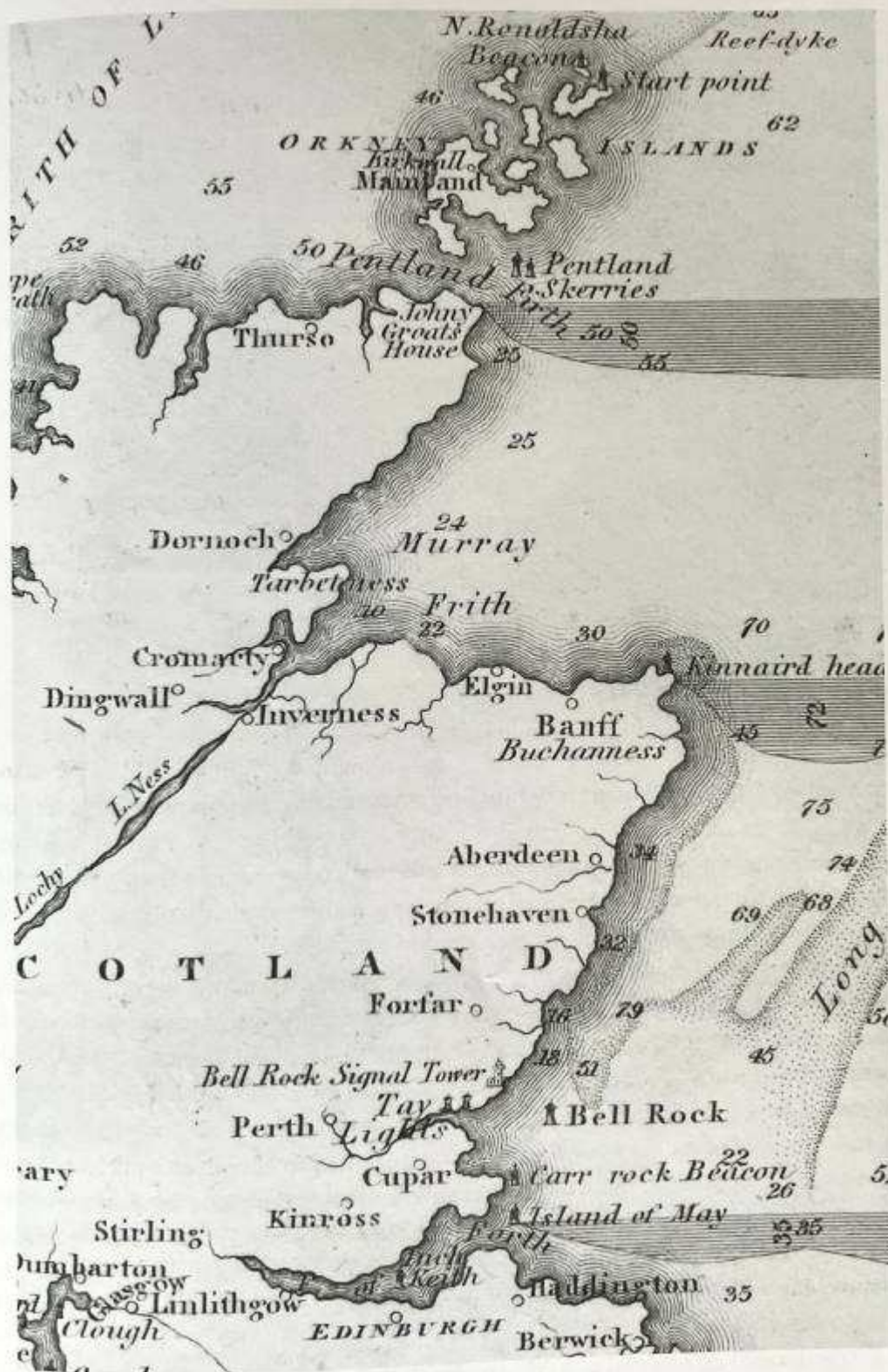
ACCOUNT OF THE BELL ROCK LIGHTHOUSE

[by Robert Stevenson]. Published anonymously as Appendix D in James Headrick's *General view of the Agriculture of Forfarshire* (1813), and now definitely attributed by the editor to Stevenson from his letters [NLS: Acc. 10706/2, 17 & 10706/8, 2]. It was written at the request in April 1811 of Sir John Sinclair. In November 1812, 12 copies of an 8-page printing of the *Account* were sent by the printer to Stevenson, who distributed them to Francis Watt and others named at the end but not, seemingly, John Rennie.]

The shores of this county [Forfarshire] are the most contiguous to the reef of rocks well known by the general name of the Cape or Bell Rock, and long so much dreaded by seamen, as to have formed one of the greatest bars to the navigation of the east coast of Great Britain. The want of some distinguishing mark to shew the place of this rock, when overflowed by the tide, was most severely felt for ages; and every philanthropic mind must rejoice that this want is so happily removed, by the erection of a lighthouse, similar to that erected about 50 years since, upon the Eddystone Rocks, in Plymouth Sound, by the celebrated Mr Smeaton [completed in 1759].

The erection of the Bell Rock Lighthouse being evidently a great improvement upon the navigation of the North Seas, and ultimately tending to the commercial advancement of the county of Forfar, in rendering more safe the approach to the harbours of Dundee, Arbroath, and Montrose, some account of the progress and completion of such an undertaking may be expected in a Report of this nature. The facts stated shall be quite authentic; but a very minute detail seems unnecessary, because there is every reason to expect the speedy publication, by Mr Robert Stevenson, engineer, of a particular account of the whole operations, illustrated by engravings [in the event it was to take 12 years to produce! (3)]. Such a work must be interesting, not only to the man of science, but to the general reader; and it is pleasant to learn, that the Commissioners for Northern Lights, have liberally encouraged such a publication [by indicating their willingness to contribute 'say £400 towards the cost' – NLS: MS. 19806, 143].

The Cape or Bell Rock lies about 11 miles south-west from the Red Head, a remarkable promontory on this coast, which it resembles in colour and nature, being red sandstone, of a fine grit. As seen at low water of spring-tides, it extends about 2000 feet in length, and about 230 feet in breadth. The north-east, or highest part, on which the lighthouse is built, is only partially dry at low water of neap-tides; but in spring-tides, this part of the rock appears from four to six feet above the water; while at high water of the same tides, it is about 12 feet under water. The surface of the rock is very rugged, and it is with difficulty that one can walk upon it. The lower parts are covered with sea weeds of the larger sorts, and the higher parts with mussels



Part of a chart of the east coast of Scotland showing the Bell Rock (3, pl. III)

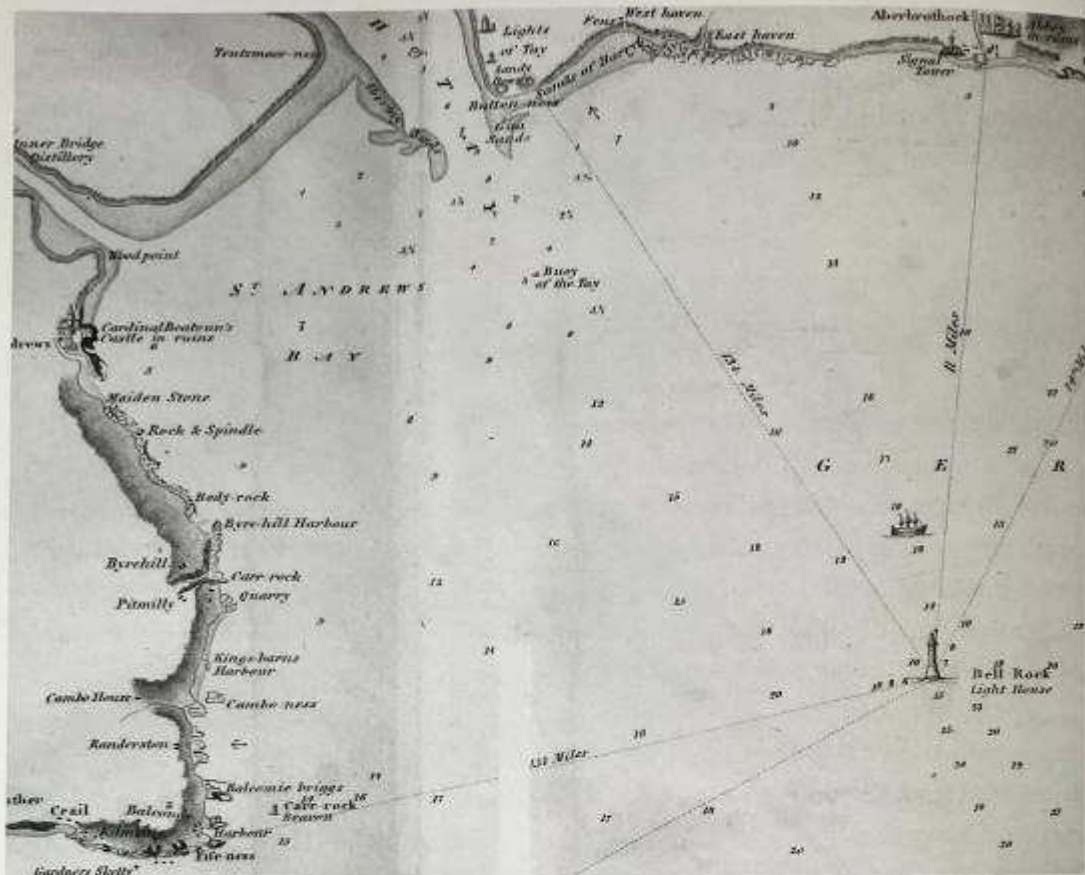


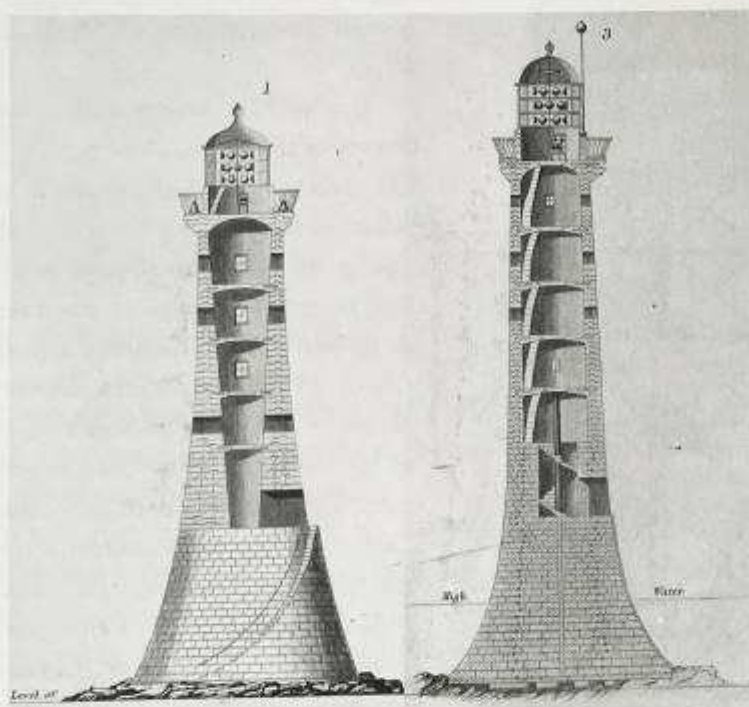
Chart of coast line adjoining the Bell Rock Lighthouse and Carr Rock Beacon. (3, pl.IV)

and whelks, and such kinds of crustaceous and testaceous animals as are common to the shores of this county; and around the rock are caught in plenty the red-ware cod, with other common fishes of these seas.

The most partial examination of any sea chart of this coast, will shew the central position which this most dangerous reef unluckily occupies, in relation to all vessels bound, either over seas, or coastwise to or from the Friths of Forth and Tay. Much as the want of some distinguishing mark upon this rock may have been felt during the earlier period of our history, yet while trade was in its infancy, the difficult and expensive nature of such a work may easily be imagined to have been sufficient obstacles to such an undertaking. If we may believe tradition, the pious inhabitants of the Monastery of Aberbrothwick, more than four centuries ago, caused a large bell to be placed upon the rock, so hung that the motion of the waves set it a-ringing, and the mariner was in this manner forewarned of his danger, which is said to have given rise to the name Bell Rock.

In the month of December 1799, the east coast of Great Britain was visited by a dreadful storm from S.S.E., when about 70 vessels, with many of their crews, were

A bill was accordingly brought into Parliament in the year 1803, which, however, was lost in the House of Lords. The subject was again resumed by the Commissioners in 1806 and a bill was brought forward by the Honourable H. Erskine, then Lord Advocate of Scotland, and seconded by the exertions of the Right Honourable President of the Board of Agriculture, Sir John Sinclair. By this bill, the Commissioners, the better to enable them to erect and maintain a lighthouse upon the Bell Rock, were allowed to extend the collection of the duty for the Northern Lights, to all vessels sailing to or from any port between Peterhead on the north, and Berwick-upon-Tweed on the south, being at the rate of three halfpence per ton upon British, and three pence per ton upon foreign bottoms. The same act authorised the Commissioners to borrow £25,000 from the three per cent. consols, which, with £20,000 of surplus light-duties invested in the funds, made up the disposable sum of £45,000 to proceed with the work.



(The Civil Engineer and Architect's Journal, 1849) Stevenson's undovetailed tower proposal of 1800–06, estimated at £42,635, sent to Rennie 28 December 1805 for consideration [NLS: MS. 19806/1], compared with the as-built design from 1807 under Rennie's overall direction. He insisted on closer adherence to Eddystone's design because of its proven stability' (3, 451). To minimise heavy sea effects he adopted a shape about 20 per cent more slender 30ft above the rock than Stevenson's, with cycloidal curves and lateral dovetailing. The outside stair was omitted. The shape and narrower walls allowed larger rooms. Within these parameters Stevenson had considerable autonomy in detailed design.

The first object was to moor a vessel as near the Bell Rock as she could ride with any degree of safety, to answer the purpose of a floating-light, and a store-ship for lodging the workmen employed at the rock [The Pharos Floating Light]. This vessel measured 80 tons. She had three masts, on each of which a large lantern was suspended, with lights, which distinguished this light from the double and single lights on the coast. Under the deck, she was entirely fitted up for the accommodation of the seamen and artificers, with holds for provisions and necessaries. Thus furnished, she was moored about two miles from the rock, in a north-east direction, in 22 fathoms water, with a very heavy cast-iron anchor, resembling a mushroom, and a malleable iron chain, to which the ship was attached by a very strong cable. In this situation, the Floating-Light was moored in the month of July 1807, and remained during the whole time the house was building, and until the light was exhibited in February 1811 when she was removed.

The bill for the erection of the lighthouse passed late in the session of 1806 [Act 46. Geo. III. c. 132, 21 July 1806. Both Stevenson and Rennie were examined by a parliamentary committee] and during the following winter, the necessary steps were taken, to have everything in readiness to commence the operations at the rock at the proper season.

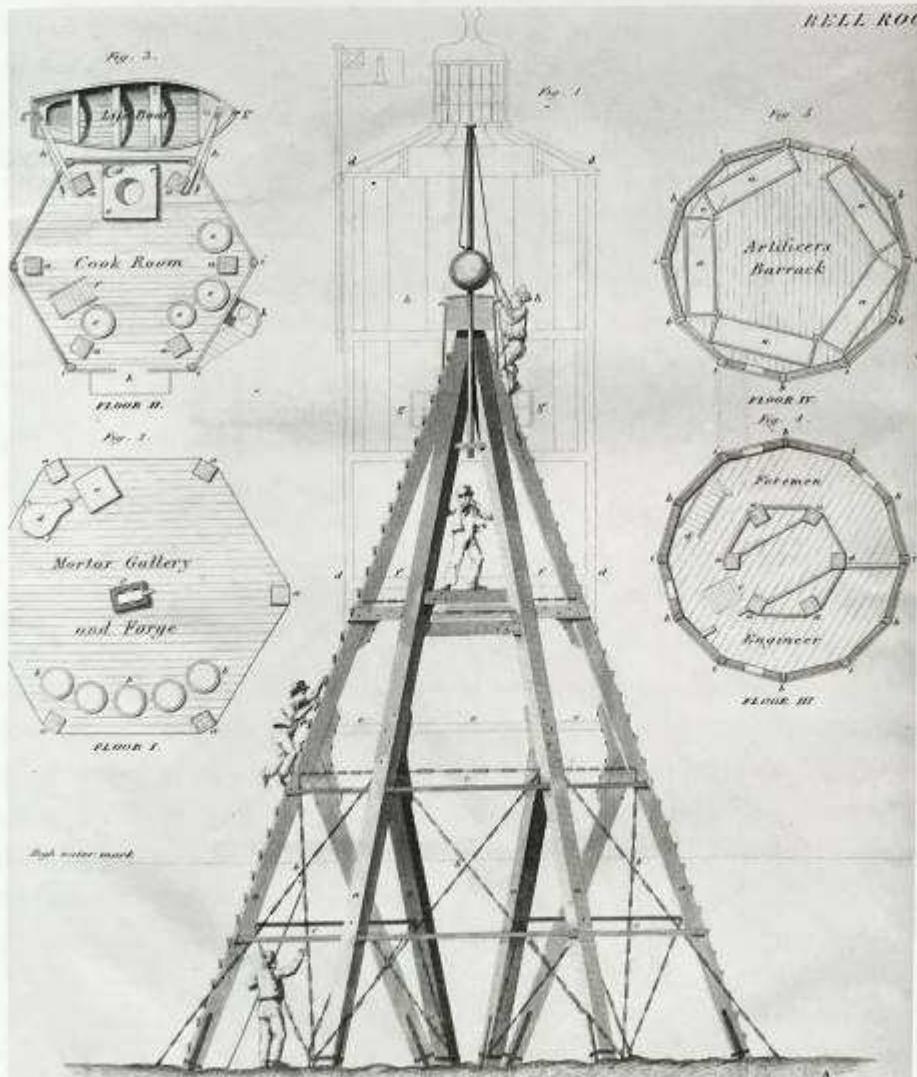
A work-yard, upon a lease of *seven years*, was provided at Arbroath, where shades [sheds] for hewing the stones, and barracks for lodging the artificers, when they landed from the rock, were erected. Vessels for conveying the stones from the quarries to the work-yard, and from thence to the rock, were hired or built; and in a few months, Arbroath, always a scene of business and activity, became now the resort of the curious, as well strangers from a distance, as people from the neighbouring towns and parishes of the county, who came to see the preparations for the lighthouse.

Early in the month of August 1807, the operations at the rock commenced, but little was got done towards preparing the rock for the site of the building, till the year following, the chief object of this season's work being to get some temporary erection on the rock, to fly to, in case of an accident befalling any of the attending boats. As the rock was accessible only at low water of spring tides, and as three hours was considered a good tide's work, it became necessary to embrace every opportunity of favourable weather, both under night, by the help of torch-light, and upon Sundays; for the water had no sooner begun to cover the rock, than all the men collected their tools, and went into the boats, which often, with the utmost difficulty, were rowed to the Floating-light.

By such exertions, this work was only to be overcome; and by the latter end of October, the work for the season was brought to a close, after erecting a beacon, which consisted of twelve beams of wood, forming a common base of 30 feet, with 50 feet of height; the whole being strongly held to the rock by bats, and chains of iron.



Forging beacon fixings and pumping foundation pit, June 1808 (3, pl. XI)

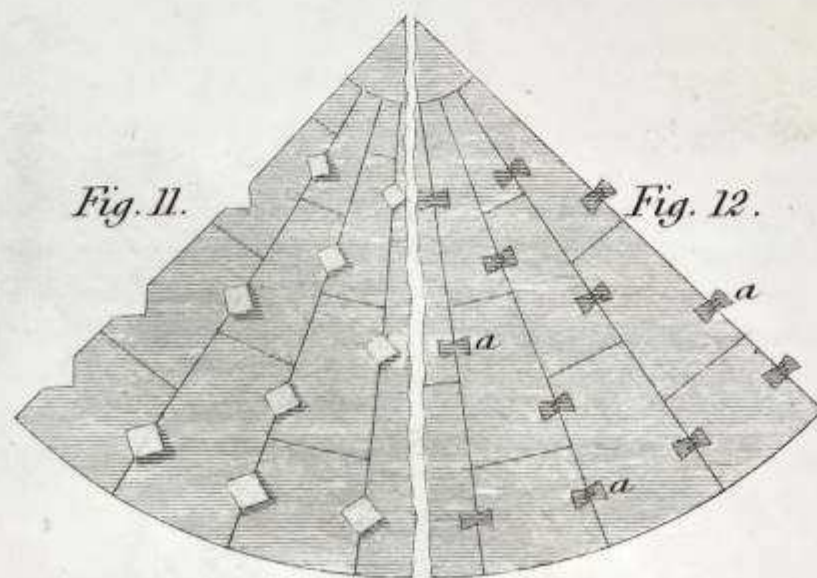


Temporary beacon 1807 before conversion into a barrack in 1808 (3, pl. VIII)

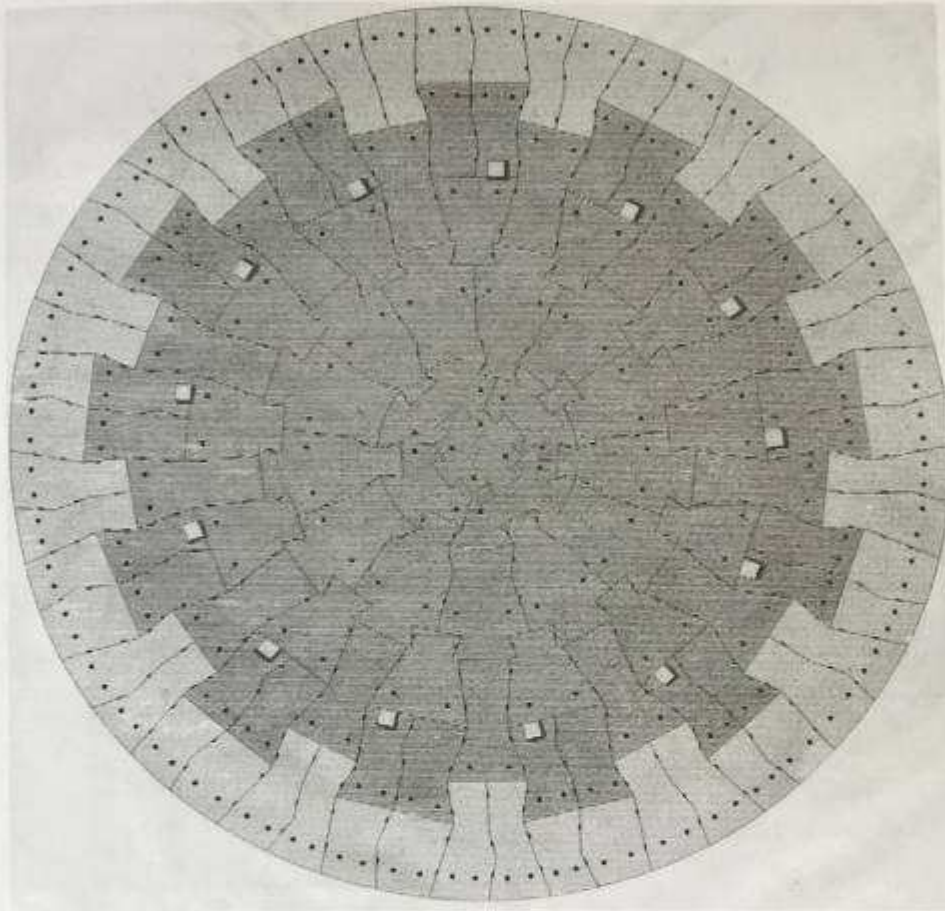
This beacon, or temporary house, was used as a barrack for the artificers while the work was in progress, and remained on the rock till the summer of 1812, when it was removed.

To the erection of this beacon, the rapidity with which the lighthouse was got up, is chiefly to be ascribed [Although Stevenson conceived and directed the implementation of this remarkable temporary work it is evident from his letters [NLS: MS. Acc. 10706/3, 21, 216] and David Logan's [NLS: MS. 19806, 147] that the design and erection of the beacon, innovative beam and balance cranes and railway were the work of Francis Watt, foreman millwright, employed from 1807-10. In his *Account* (3, 496) Stevenson acknowledged that he had 'often profited by Watt's ingenuity'] and it is extremely doubtful if ever it would have been accomplished, without some such expedient, certainly not without the loss of many lives; for in a work of this nature, continued for a series of years, it is wonderful that only one life was lost on the rock, by a fall from a rope-ladder when the sea ran high [Charles Henderson, a smith, 16 October 1810 (3, 391)], and another at the mooring-buoys, by the upsetting of a boat [James Scott, a seaman on the Smeaton 21 September 1808 (3, 353)].

The operations of the second season were begun at as early a period as the weather would permit, when the preparation of the rock was proceeded with. The risk, and often excessive fatigue, which occurred every tide, in rowing the boats to and from the rock to the Floating-light, made it necessary to have a vessel, which,



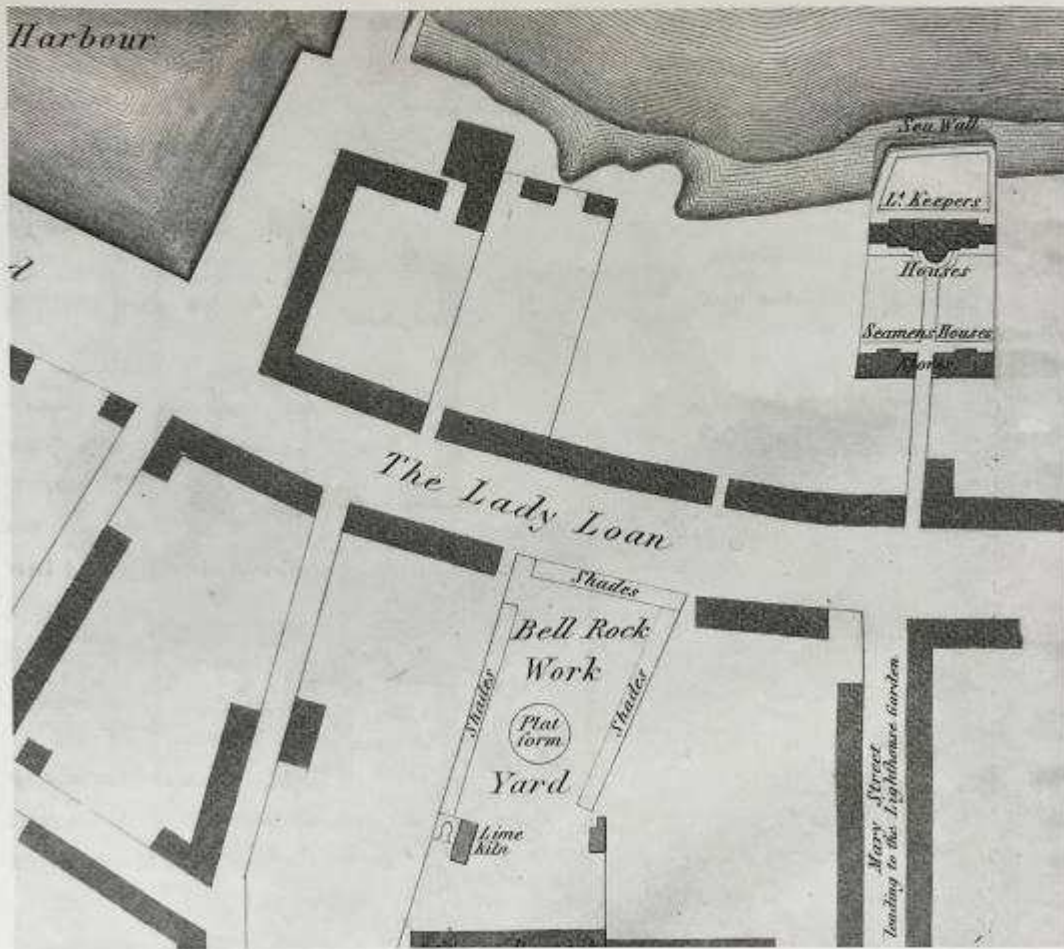
(3, pl. VII)



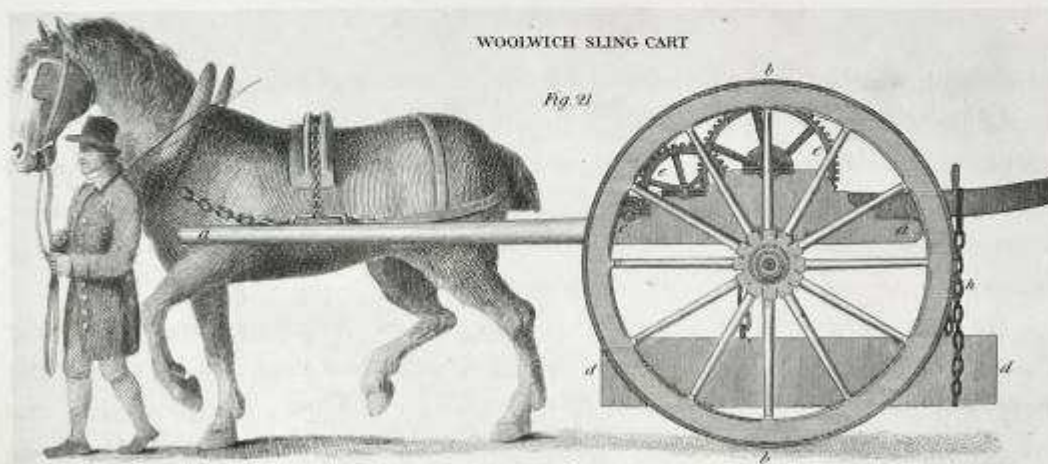
Opposite page: Stevenson's proposed undovetailed Bell Rock Lighthouse courses 1800-06 secured by stone joggles or iron bats (a), compared with [above:] the first entire masonry course as built at Rennie's insistence with dovetailing. (3, pl. XIII)

in blowing weather, could be loosened from her moorings at pleasure, and brought to the lee-side of the rock, where she might take the artificers and attending boats on board. A vessel of 80 tons was accordingly provided, and named *The Sir Joseph Banks*, in compliment to that worthy baronet, who, ever ready in the cause of public improvement, had lent his aid in procuring the loan from Government for carrying this work into execution.

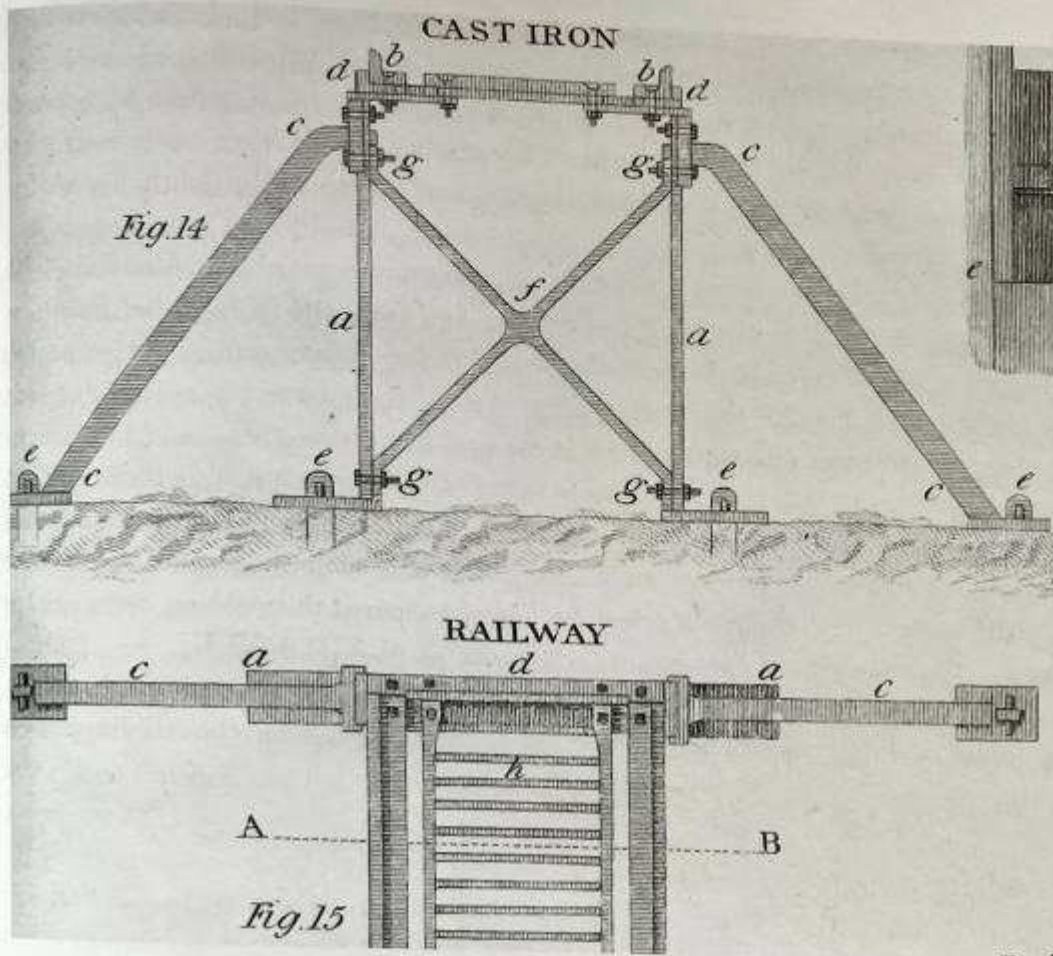
Through much perseverance and hard struggling with the elements, both during day and night tides, the site of the lighthouse was got to a level, and cut sufficiently deep into the rock. Part of the cast-iron rail-ways, for conveying the stones along the rock, were also got ready: so that on Sunday 10th July 1808, the foundation stone was laid [By Stevenson, in the presence of leading foremen Peter Logan and Francis



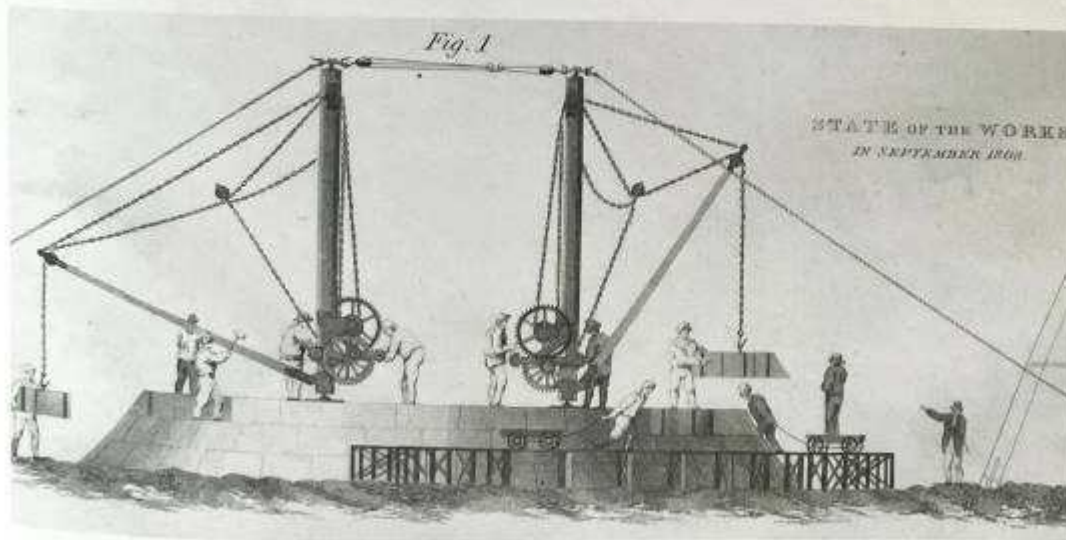
Lighthouse work-yard and shore station, Arbroath. (3, pl. XII)



James Craw and 'Bassey' transporting stone to and from the work-yard. (3, pl. X)



Railway designed by Watt in 1808 - side stays added by Slight 1819. (3, pl. X)

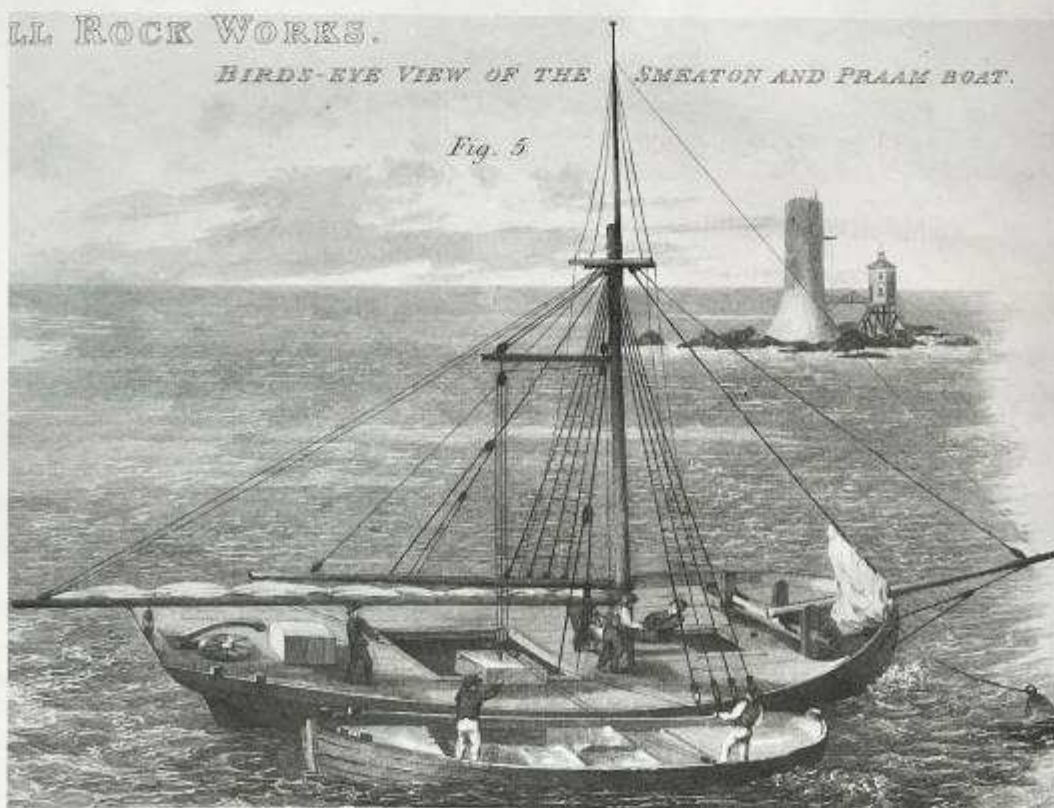


The innovative beam cranes and railway in operation in 1808. (3, pl. IX)

Watt, who applied square, level and mallet to the stone with the benediction 'May the Great Architect of the Universe complete and bless this building.' (3, 238). Two days later he formally took over from Smith as Engineer to the Northern Lighthouse Board (2, 20)]; and by the latter end of September, the building operations were brought to a conclusion for the season, the first four courses of the lighthouse having been completed.

A stock of materials being procured from the granite quarries of Aberdeenshire, for an outside casing to the height of 30 feet, and from the [Kingoodie] freestone quarries of Mylnfield, near Dundee, for the inside and upper walls, a great number of masons were kept in the work-yard at Arbroath, and every preparation made during the winter months for the work at the rock against next season. [At the work-yard, as an evening occupation to benefit some of the men, no doubt encouraged by Stevenson who paid great attention to training, architectural drawing was taught by David Logan, Clerk of Works – engineering assistant – who in later life became the Chief Engineer of the Clyde Navigation. Logan prepared the working drawings for the as-built tower, including one for each course (3, pl. XIII & XVI)].

The stones were wrought with great accuracy, and laid upon a platform, course by course, and there numbered and marked as they were to lie in the building, when



Off-loading stone into a pram-boat for taking to lighthouse – June 1810. (3, pl. XI)

they were laid aside as ready for shipping for the rock;— a part of the work which was performed with wonderful dexterity; for the vessels which carried them away, were generally dispatched with their cargoes on the tide following that of their arrival.

At the commencement of the operations in April 1809, the four courses built last season were found to be quite entire, not having sustained the smallest injury from the storms of winter. In the arrangements for the work, the first thing to be done was to place the moorings for the various vessels, and stone boats employed in attending the rock, and landing the materials. The machinery for receiving the stones from the praam-boats was erected, and cranes for laying the stones in their places upon the building. With an apparatus thus appointed, the lighthouse was got to the height of thirty feet by the month of September 1809, when the work was again left off during the winter months. Early in the spring of the year 1810, the building was again resumed, but with very faint hopes of bringing the whole to a close in the course of this year: however, as it fortunately happened, not a single stone was lost or damaged, and, by the month of December [On 2nd September 1810, Stevenson laid the last stone, the upper step of the stair — the wooden bridge to the beacon was removed. (3, 388)], everything was got into its place; and the interior having soon after been finished, the light was exhibited, for the first time, on the night of the 1st February 1811.

Having now, in a very general way, noticed the various stages of the erection of the Bell Rock Lighthouse, it only remains to give some of its dimensions, and a few other particulars.

The foundation-stone of the lighthouse is nearly on a level with low water of ordinary spring-tides, and consequently the lower part of the building will be about 15 feet immersed in water when the tide has flowed to its usual height at new and full moon. But during the progress of the work, the sea spray has been observed to rise upon the building to the height of 80 feet; and upon one occasion to 90 feet, even in the month of July. The house is of a circular form, measuring 42 feet diameter at the base, from which it diminishes as it rises, and only measures 13 feet at the top, where the light-room rests: Including which, it measures in height altogether 115 feet. To the height of 30 feet it is entirely solid, excepting a drop-hole for the weight of the machinery which moves the reflectors, which hole is only ten inches diameter. The ascent to the door, which is placed at the top of the solid, is by a kind of rope-ladder. A narrow passage leads from the door to the stair-case, where the walls are seven feet in thickness: at the top of the stair-case, which is 13 feet in height, the walls get thinner, and diminish gradually to the top.

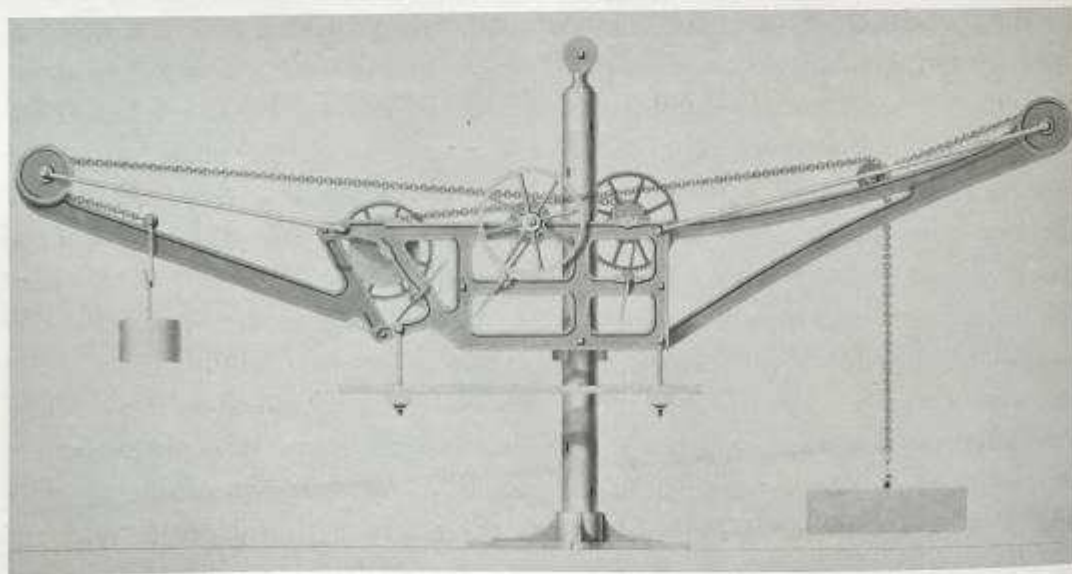
Above the stair-case, the ascent to the different apartments is by means of wooden-ladders; and the remaining 57 feet of masonry is divided by five stone floors

into rooms for the light-keepers, and stores for the light, and the light-room is placed on the top of the building. The three lower apartments have each two small windows, while the upper rooms have each four windows; and the whole are provided with strong shutters, to defend the glass against the sea in storms.

The two first courses of the building are entirely sunk into the rock; and the stones of all the courses are dove-tailed and let into each other, in such a manner as that each course of the building forms one connected mass, and the several courses are attached to each other by joggels of stone and oaken trenails, upon the plan of the Eddystone Lighthouse formerly alluded to. The cement used at the Bell Rock was a mixture of pozzolana earth, sand and lime; which last was brought from Aberthaw in Wales, where the lime for the Eddystone Lighthouse was got.

Round the balcony of the light-room, there is a cast-iron rail, curiously wrought like net-work, which rests on bats of brass. The light-room is 12 feet diameter, and 15 feet in height, made chiefly of cast-iron, with a copper roof. The windows are glazed with large plates of polished glass, which is one quarter of an inch thick.

The light is from oil, with Argand burners, placed before silver-plated reflectors, hollowed out to the parabolic curve. That the Bell Rock light may be distinguished from all others on the coast, the reflectors are ranged upon a frame which is made to revolve upon a perpendicular axis once in three minutes. Before some of the reflectors are placed shades of red coloured glass; so that the effect produced in each revolution of the frame with the reflectors, is a light of the natural appearance, and a light with the rays tinged red, with intervals of darkness between the lights. In a favourable



*Logan's drawing of Watt's iron balance crane used to erect the lighthouse tower.
© NLS: MS. Acc. 10706 (for a published version with plan see 2, 39)*



*Light-room, with revolving array of silvered copper reflector lamps, signal ball, fog bells and ornamental iron balcony railing.
(3, pl. XX)*

state of the atmosphere, these lights are so very powerful, as to have been seen at the distance of 25 miles. During the continuance of thick and foggy weather, two large bells are tolled night and day, by the same machinery which moves the lights; and as these bells may be heard in moderate weather considerably beyond the limits of the rock, the mariner may be advertised of his situation, in time to put about his vessel before any accident can happen; for in thick and hazy weather, she might otherwise run ashore upon the rock, notwithstanding the erection of the lighthouse.

About the commencement of these works, it was a very common saying, that: 'Although the Bell Rock Lighthouse were built, (which it never will be), no one will be found hardy enough to live in it.' The sequel has, however, shewn the fallacy of such a supposition; for no sooner was the house ready for possession, than numerous applications were made for the situation and many were of course disappointed. Of these applicants, a principal light-keeper and three others were nominated, and took up their abode at the term of Martinmas 1810 [November 11], and each in his turn

gets ashore on liberty at the end of every six weeks, and remains a fortnight, when he goes off to the lighthouse again.

The pay of the light-keepers is about £50 *per annum*, with provisions while they are at the lighthouse; but ashore they provide themselves. At Arbroath, there are buildings erected, where each keeper has apartments for the accommodation of his family; and, connected with this establishment, there is a very handsome signal-tower, 50 feet in height, in which an excellent telescope is kept, and signals arranged with the people at the rock for the attending vessel; this vessel is about 40 register tons, and is capable of carrying a large enough boat for landing at the rock in moderate weather, with stores, provisions, fuel and water; and the master of this vessel has also the charge of the stores at Arbroath.

This establishment, which is as complete as can well be imagined, says much for the humane consideration and proper liberality of the Honourable Board of Commissioners. At present, the exact amount of the expence of the erection of the lighthouse, and establishment connected with it, cannot be ascertained, but will probably be about £55,000 Sterling. Whether, therefore, we look to the peculiar position of the reef on which this lighthouse is built, or to the success which has attended the operations, from their commencement in 1807, to the period of their final conclusion in December 1810, this work will be found to do equal honour to the spirit and resources of the age in which we live.

As many of the seamen and artificers engaged in this memorable work claim kindred to the county of Forfar, besides those brought from Mid-Lothian, Aberdeenshire, &c. &c. it may be proper to mention, much to their honour, that the Magistrates of Arbroath give the most ample testimony of their orderly conduct during the three years which the work was going forward; and having been engaged in the erection of the Bell Rock Lighthouse, will always be a sufficient passport for abilities in the line of their profession. Although in a work of such extent, necessarily divided into various departments, it would be impossible to mention all who signalised themselves for their faithful exertions, yet we cannot withhold the mention of the following gentlemen, upon the best authority:

Mr Peter Logan, foreman to the building operations at the rock

Mr David Logan, draughtsman, and foreman at the work-yard.

Arbroath [Also designated 'Clerk of Works' by Stevenson (3, p.490)]

Mr Francis Watt, foreman of the joiners

[Also designated 'foreman mill-wright' by Stevenson who, on 26 November 1812 went to some trouble to get a copy of the separate printing of this *Account* to Watt, "I will carry [one] to Arbroath with me tomorrow and give to Captain Brown who occasionally tells me of your welfare and who will know your address in London" [NLS: Acc. 10706/8, 2].

Mr James Dove, foreman of the smiths. [d. 1843]

Mr James Slight, mould-maker. [1786-1854, became a civil engineer]

Captain James Wilson of the Floating-light, and landing-master at the rock.

Captain David Taylor of the Sir Joseph Banks tender. [1768-1843]

Captain Robert Pool of the Smeaton stone-lighter.

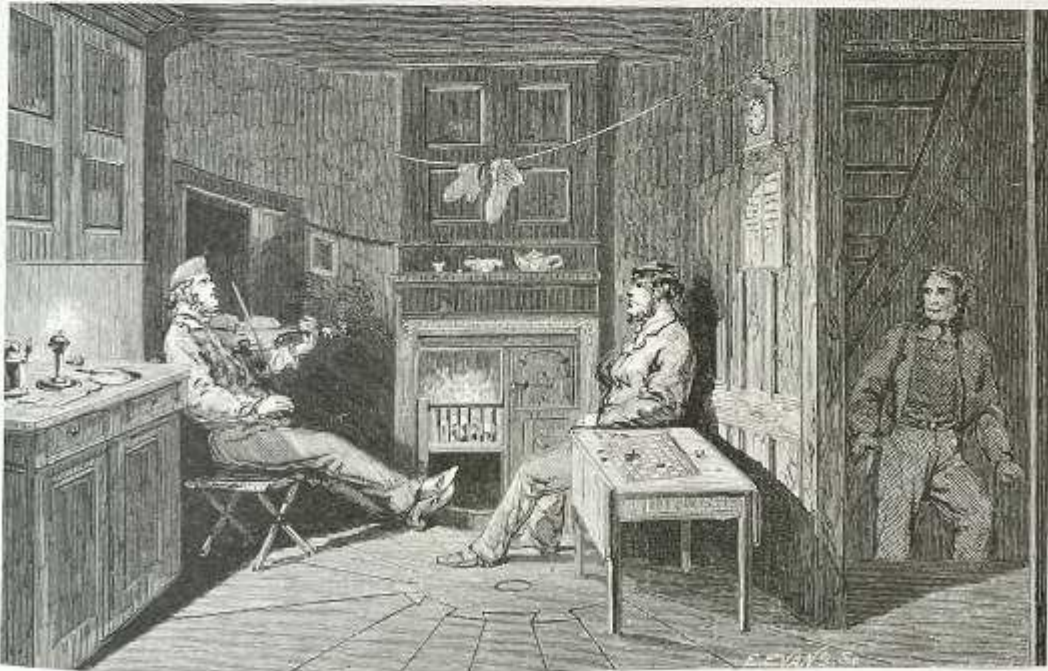
Captain James Spink of the Patriot stone-lighter.

Captain John Reid, acting-master, and principal light-keeper of the Floating-light. [1753-1843]

And Mr Lachlan Kennedy, clerk and cashier, Engineer's Office.

Several of these gentlemen are still in the Lighthouse service; while others have removed to works of celebrity, or are engaged in business on their own account.

It must be a matter of very general satisfaction to learn, that the lighthouse, in its entire state, has sustained no injury whatever from the storms of the first and second winters. And we shall conclude these remarks with observing, that Mr [John] Forrest, the Superintendent for the instruction of the light-keepers, after remaining at the lighthouse from December 1810 till April 1811, reported, that '*the lighthouse was as dry and comfortable as any house in Edinburgh.*'



Bell Rock Lighthouse kitchen in 1865, as used by R.M. Ballantyne when writing his story of the great struggle between man and the sea to create the lighthouse (9). To get a feel for his subject he lived in the finely appointed 'Stranger's Room' or library under the light-room for a fortnight. Note the dovetailed cantilever ends in the floor insisted on by Rennie.

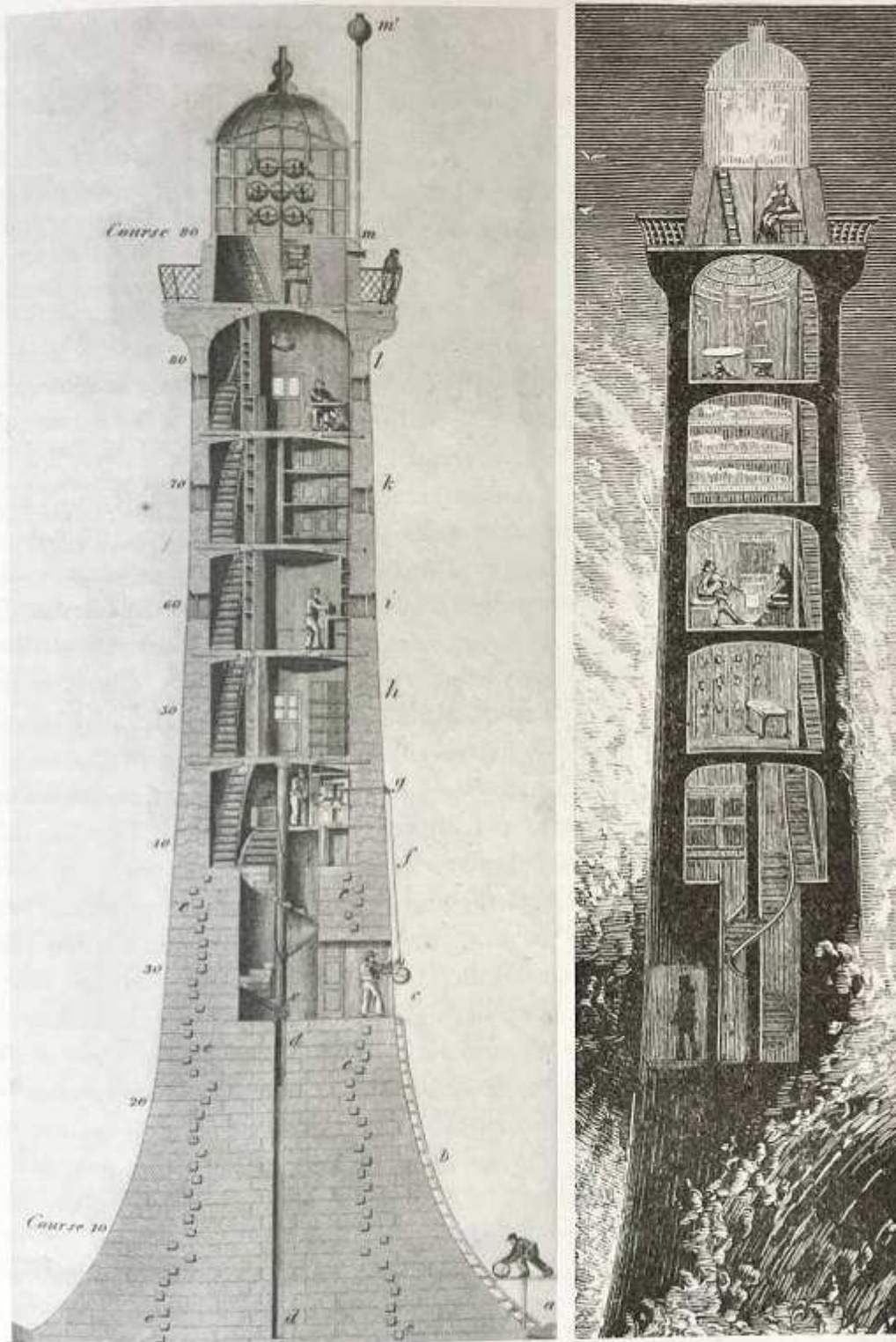


*Above: The library or 'Strangers Room' from a painting by R.M. Ballantyne, who occupied the room in 1865 when writing *The Lighthouse*. Complete with Turkey carpet, the marble Stevenson bust and tablet, pedestal table with bible (prayers were regularly read here), open bookcase and other fine fittings of oak timber executed in Mr. Trotter of Edinburgh's best style ... [and] handsomely decorated panel-work painted by Mr. Macdonald of Arbroath'. It is understood that the room remained more or less like this until the 1960s.*

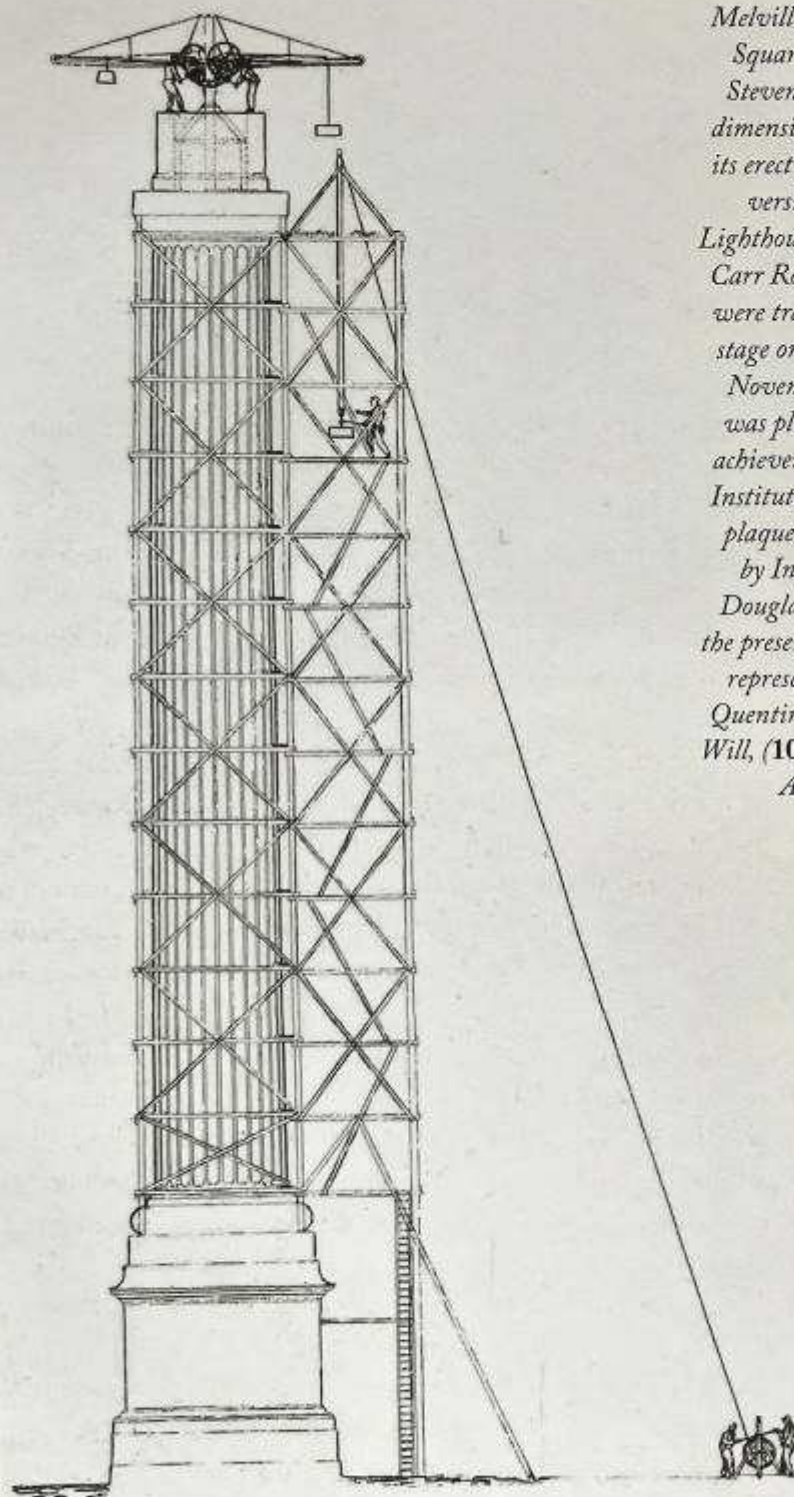
© NLS: Acc. 11962



Below: Bell Rock Lighthouse during a gale (6)



Logan's section of the completed lighthouse with its 90 courses and 'War without and peace within' - R. M. Ballantyne's artistic frontispiece of The Lighthouse compared, to show its internal arrangements - 1811-1865. (3, pl.XVI) (9)



Melville Column, St. Andrew Square, Edinburgh, 1821. Stevenson gave the as-built dimensions and superintended its erection using an improved version of the Bell Rock Lighthouse balance crane used at Carr Rock (3, 520). The stones were transferred on a landing stage on top of the staging. In November 2003 the writer was pleased to recognise this achievement by organising an Institution of Civil Engineers plaque, which was unveiled by Institution President, Douglas Oakervee, OBE, in the presence of Stevenson family representatives Jean Leslie, Quentin Stevenson and James Will, (10) (2, 49) © NLS: MS. Acc. 10706. 356.

Bell Rock Lighthouse

Report by John Rennie to the Commissioners of Northern Lights &c.,
Edinburgh 2 October 1809.

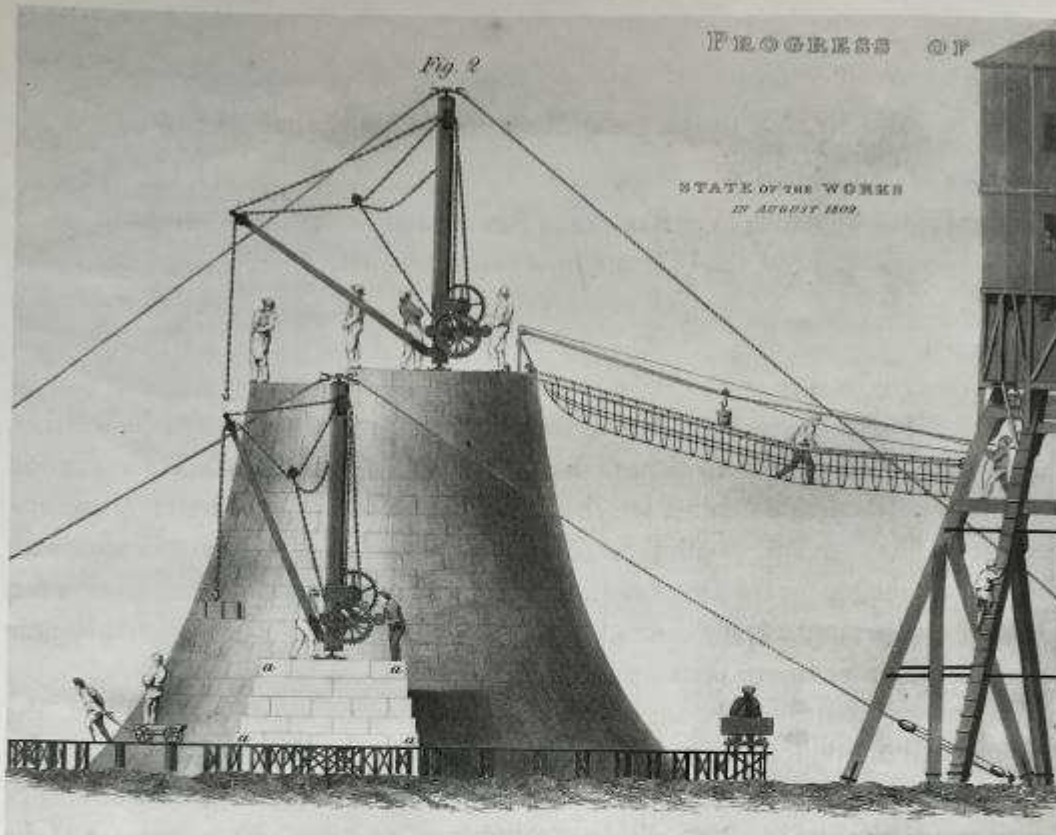
[Omitted from Appendix IV – Reports of Rennie and Stevenson –
in Stevenson's *Account* of 1824 (3) and now first published]

Gentlemen,

I went to Arbroath on the 22nd [September] but owing to the badness of the weather, I did not get out to the Bell Rock until the 24th when I was fortunate in having a good ebb and very favourable weather which enabled me to examine the building and the Rock round its foundation with great correctness as also the state of the beacon with the place on the top for the accommodation of the workmen and the iron railways &c. [This statement emphatically contradicts D. Alan Stevenson's conjecture that Rennie only 'saw the tower from a distance about high-water' (7, 301)]

The tower for the lighthouse is now raised to the height of about 30 feet. The outside is all of granite except the two upper courses which are of Kingoodie stone [From Mylnfield, on the north side of the River Tay, five miles west of Dundee] & I have much pleasure in saying that the work is well executed and the cement of the best quality no part of which has in any degree failed. While however [in] the courses of stone now laying under the level of the tide it would appear that some small part of the green mortar had been washed out and there is a little weeping of water in those places, but this is very trivial. I have directed it to be examined and filled with grout and if a little oakum is put into them to secure the grout until it has time to harden and the outside is then pointed with Roman Cement there is no doubt that the whole will be perfect. [This again contradicts D. Alan Stevenson's conjecture that Rennie never gave directions (7, 301). Rennie, from his considerable experience of hydraulic mortars and contacts, also specified and sourced the Roman Cement and pozzolana earth used for jointing the masonry].

The rock round the foundation of the tower does not appear to waste & some small rub[b]le of cement which had been laid round it the end of last year ... is as perfect as the day it was laid. [It] is true the building was then so low that there could be no heavy action of the sea against it but where the vacancies are filled in with stone as intended I have no doubt that the action of the sea will not produce any material effect on it. The curve of the outside of the tower answers fully to every expectation I had formed of it, the sea plays with ease round it and I trust it will be found when finished the completest work of its kind. [Contrary to the conjectures of D. Alan



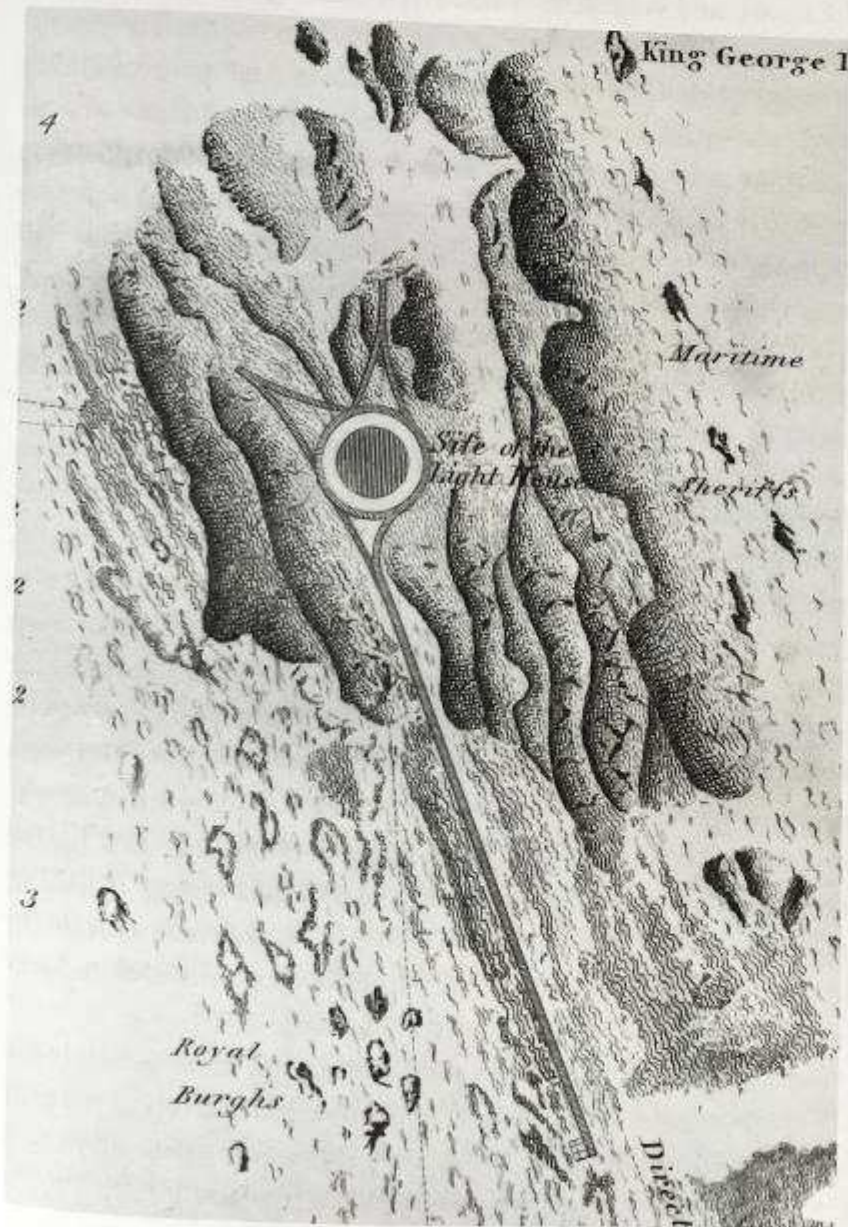
Bell Rock Lighthouse works August 1809. Rennie visited the site on 24 September 1809, and examined the tower at a height of 31 ft 6 in, with about 60 per cent of its masonry laid (3, 471). It was almost certainly past the greatest danger of demolition by heavy seas. This was probably Rennie's last site visit before its completion in 1810. Note the innovative cranes, railway and beacon conceived and directed by Stevenson, designed and erected by Francis Watt, and approved by Rennie. (3, pl. IX)

Stevenson (7, 301). The implementation of the cycloidal curves, slenderer tower and dovetailing of Rennie's plan undoubtedly reduced the risk of storm damage in heavy seas, particularly at or near High Water level during construction of the first 30 ft of the tower.]

The beacon has shook considerably by the swell of the sea that breaks on it not by a regular vibration in the direction of its height but by a kind of twist. Mr. Stevenson has very properly directed side braces to be put to the main braces of it, and all the iron chains and work to be tightened up which I have little doubt will render it secure. This beacon has been a very expensive work, but it has been of great use in facilitating the operations at the rock, and it will be important to secure it in such a manner as to stand for another year which I hope the measures now taking will

enable it to do. [Rennie would have met some of the 24 workmen accommodated in the beacon still engaged until November on laterally bracing its supports and extending the railway.]

Mr. Stevenson has thought proper to increase the number of landing places and to lay down iron railways from thence to the tower, these are attended with a heavy expense, but no doubt they will facilitate the conveyance of stone to the tower. I was however in hopes some part of this expense would have been saved [Rennie reluctantly accepted the increase in the number of landing places and railway extension as traditionally the resident engineer had considerable autonomy in the design and construction of temporary works.]



*Bell Rock - Plan
showing the
proposed railway
from the landing
places to the
lighthouse site.
(3, pl. V)*

I come now to a subject much less pleasant namely the supply of stone from the Kingoodie Quarries. When the contract was entered into with Mr. Mylne the quarry had a favourable appearance and there was no doubt entertained by any one that a most ample supply of stone for the work might be had from it but unfortunately this has not been the case, the quarry having in a great measure failed in respect to the production of large blocks of stone. From the best information I have been able to procure Mr. Mylne has not been deficient in exertions but the quarry has become so deficient in its supply of large blocks that he has been unable to comply with his contract.

Notwithstanding, every block fit for the works of the Bell Rock have been appropriated to it. On the 25th September I examined the quarry [Kingoodie] with Mr. Logan Junr. [David Logan], and consulted with Mr. Mylne's agent and the mason belonging to the Commissioners who was sent to examine the work what was the utmost that could be expected from this quarry by the middle of next month and they were of opinion that not above 200 tons could be produced and as this [frost susceptible] stone does not answer to be quarried in Winter there appears no hope that the men can be kept employed in the Work Yard longer than about Christmas. A necessity therefore exists of getting stone from some other place or discharging at least one half of the masons, a measure which will not only occasion great delay in the completion of the work but incur a great additional expense in the completion of the lighthouse.

The solid part of the tower being compleated the rest of the work should proceed with much greater celerity. There is stone enough at Arbroath to compleat the stair case part which is about 20 feet high, indeed nearly half of this is already built on the platform in the Work Yard and the rest may probably be done by the end of next month. The stone that is expected from Kingoodie will complete two stories more, three stories and the cornice and platform will then be wanted which may probably require five hundred tons of stone, and my advice is that the stone should be got from the quarries of Craigleith which will cost a little more than that from Kingoodie, but as the quality is as good for standing the spray & weather and as the delay of one year will probably incur an additional expense of at least £5,000, I cannot hesitate a moment in recommending this measure to the immediate attention of the Commissioners. [Stevenson acted on Rennie's advice and Craigleith stone was used for the cornice and light-room wall from the 81st course upwards (3, 371 – page 71), about 1,700 cubic feet before dressing.] The establishments of vessels, superintendants &c is very heavy and the sooner this is reduced the better as the work will be found sufficiently expensive with all the œconomy that can be practised.

The manner of dovetailing the stones of the solid part of the tower is nearly the same as that of the Eddystone and this plan will be followed to the top of the stair case. I have however to recommend a mode some what different for the hollow part of the surrounding wall of which should be dovetailed in a mode I have already drawn out. [This and other sketches of alterations by Rennie to Stevenson's work

were still in David Logan's possession in 1820, including *the courses as undovetailed at the centre which were adopted by Mr. Stevenson but afterwards rejected by Rennie*. [NLS: MS. 19806, 147-150]. In actioning this rejection Stevenson sent Rennie a drawing of one of the *courses at the centre dovetailed to the centre stone for your approbation* [2.9.1807. NLS: MS. 19806, 33.] pointing out that the stone laid aside could be used elsewhere [NLS. MS. 19806, 33]. This, and other letters in the Rennie archive, contradict D. Alan Stevenson's conjecture that Rennie did not produce any drawings other than the tower outline and that the working plans were not submitted for Rennie's approval (7, 205). Even temporary works were discussed with Rennie and his advice sought [April 1808. NLS: MS. 19806, 65-67].

The stone floors in the Eddystone were formed by an arch in the form of a dome springing from the surrounding walls to strengthen which chain bars were laid into the wall. I propose that these should be done with large stones radiated from a circular block in the middle to which their interior ends are to be dovetailed as well as the radiated joints and then connected to the surrounding walls by means of a circular dowel. By this means the lateral pressure on the walls will be removed, the whole will be connected as one mass and no chain bars will be wanted except under the cornice. [This proposal, a development of Stevenson's 1800-06 design concept but incorporating end dovetailing, was adopted. The ring chain bar referred to was let into a groove in the 81st course which was the springing of the cornice and top apartment dome.] Thus the whole will be like a solid block of stone excavated for the residence of the light keepers, stores, &c.

The outside stone should not be dressed so smooth as it is now doing. As by the use of Craigleith stone I have great reason to believe if the next Summer should prove any way favourable for working on the rock that the light house will be completed. [The mason-work was completed on 2nd September 1810.]

I advise that the lantern should be prepared without loss of time and I beg leave to recommend to the Commissioners the use of coloured glass in the light similar to what has been lately practised in some of the new light houses built by the Trinity House of London. One of them has been seen lately by Mr. Stevenson as well as myself and we consider it a great improvement in the distinguishing of the lights. Whether the red glass used in these lights is the best that can be adopted I will not pretend to say, but this point can easily be ascertained by experiment. [Red glass was used on Stevenson's initiative.]

I am,

Gentlemen,

Yours &c.

[John Rennie]

The Commissioners
of Northern Lights
&c. &c. &c.

Editor's notes

Transcribed by myself from Rennie's 'Reports' [pp 296–8] at the Institution of Civil Engineers' library in London, which is probably the only surviving text, no copy having been located in Scotland.

A note from the Northern Lighthouse Commissioners' Secretary Charles Cunningham dated 25 December 1810 confirmed that he was ready to settle Rennie's bill for the September/October 1809 visit and report. In all, Rennie is understood to have received £440 from the Northern Lighthouse Board for his Bell Rock Lighthouse work (7, 304).

Rennie is known to have made at least four working visits to the Bell Rock from 1805–09. These were on 16 August 1805 [3, 447]; 6 October 1807 (inspecting foundation work and the beacon as just completed before its conversion into a barrack the following year) [3, 463]; 25 November 1808 (inspecting the beacon and first four courses) [NLS. MS. 19894, 15]; and 26 September 1809 (inspecting the tower masonry about 60 per cent complete and work in progress strengthening the beacon and on extending the railways).

D. Alan Stevenson was aware of the first two visits, but states that Rennie also visited the rock in December 1808 and October 1809 (7, 304), which probably refer to the November 1808 and September 1809 visits. If so, this and the other contradictions of Rennie's role already noticed, suggest that D. Alan Stevenson had not seen Rennie's report of 2 October 1809 when writing his book in 1959 (7).

Appendix A

John Rennie's letter of 12 March 1814 to Matthew Boulton

[Partly first published in Smiles, S., *Lives of the Engineers: Smeaton and Rennie*. London, 1874, 295, and in subsequent editions]

London March 12th 1814

Private

Dear Sir

I duly received your letter of yesterdays date & shall with much pleasure comply with your request.

Mr Robert Stevenson was bred a Tin Smith & Lamp Lighter in which line he was employed by a Mr Thomas Smith a considerable Manufacturer in that line in Edin[bu]r[gh] & who had the care of the Reflectors & Lamps belonging to the Commissioners of Northern Lights. While in Smith's employment he married His Daughter, & Smith, advancing in years, employed Stevenson to Look after the Northern Lights. This he did for several years, when Smith declined the situation, & Stevenson was elected in his place. When the Bell Rock Light House was erected, Stevenson was employed to Superintend the whole, there being a regular Mason under him & a carpenter. The original plans were made by me, & the work visited from time to time by me during its progress. When this work was Completed Stevenson considered that he had acquired sufficient knowledge to start as a Civil Engineer & in that line he has been most indefatigable in looking after employment, by writing & applying wherever he thought there was a chance of Success. But few weeks passed without a puff or two in the Edin[bu]r[gh] Papers. He has taken the Merit of applying Coloured Glass to Light Houses which he stole from Huddart & I have no doubt the whole Merit of the Bell Rock Lighthouse will, if it has not already been [be] assumed by Him. He has not however been successfull in getting into employment as a Civil Engineer and in Consequence being a partner in the Greenside Co[mpan]y has lately Started a Manufactory of Steam Engines, & I have no doubt the principal if not the sole object of his sending a Man to your Manufactory, is to acquire information respecting them, & to entice away some of your principal Workmen. You ought therefore to be particularly Circumspect

in your transactions with this Man & by no means to admit him or any of his people into your Manufactory.

I am much obliged by your enquiries after my health which instead of suffering from the severe weather has rather improved by it. When this weather will end God only knows. We had a heavy fall of snow here yesterday which now lies thick & the frost is very sharp. I hope this will find Miss Boulton & yourself in perfect good health as also Mrs. Watt and Mr. Ja[me]s W[at]t to whom please to make my [best?]

Compliments.

I remain

Dear Sir

truly yours

John Rennie

*M. R. Boulton by
Soho*

Letter of John Rennie (1761–1821)
to Matthew Robinson Boulton (1770–1842), 12.3.1814. (11)
Boulton Papers, Birmingham Central Library
Transcribed by W. T. Johnston: 18.5.2010.

Editor's notes

The context for this private letter was a business enquiry into Stevenson's background from Boulton & Watt who were furnishing the plated metal for the silvered-copper parabolic lamp reflectors to the Greenside Company, who by then had begun making them for the Northern Lighthouse Board. Previously Boulton & Watt had supplied the reflectors ready formed. The Greenside Company of which, according to Rennie, Stevenson was a partner, wished to send a coppersmith to Boulton & Watt's Soho Works to receive instruction in management of the metal and reflector polishing.

The disparaging element in the letter is not the first known instance of this Rennie characteristic. In November 1806 he had been remarkably critical to Stevenson about Telford (in the context of the latter's 'preparatory step for making a design for the lighthouse in 1803 in association with Murdoch Downie'). Rennie wrote: '[Telford] has no originality of thought and has all his life built the little fame he has acquired upon the knowledge of others, which he has generally assumed as his own'. [NLS: MS. Acc. 10706, 73, f. 55]. These unworthy generalisations were probably

fuelled by Rennie's resentment of Telford's parliamentary based progress in improving the infrastructure of the Scottish Highlands. In April 1805 Telford had found it necessary to counter Rennie's illiberal treatment of his character in every quarter in a letter to James Watt [Rolt, L.T.C. Thomas Telford , 1958, 149].

Even allowing for some over-reaction by Rennie, he clearly felt strongly by 1814 that Stevenson was beginning to assume the whole merit of the Bell Rock Lighthouse. Rennie's outline of their roles on the project was based on his own extensive experience. This is still typical of the traditional chief engineer/resident engineer relationship, with the former setting and taking responsibility for the main design and execution parameters and the latter preparing the working and temporary works drawings and receiving only occasional site visits from his chief. From some of his comments Stevenson seems to have expected more of Rennie, but this was his first experience of such an arrangement and an engineering project on this scale.

In his comment about the merit of applying coloured glass to lighthouses, Rennie was probably reflecting the view of his friend Capt. Joseph Huddart (1741-1816), a leading authority on marine surveying and harbour engineering. Stevenson certainly developed this concept.

Regarding Rennie's conjecture about the Greenside Company's interest in gaining information on steam engine manufacture it seems unlikely that Stevenson would have wished to be involved in an operation of this technical complexity. In 1825, when invited by David Brewster to write the article 'Steam Engine' for the *Edinburgh Encyclopaedia*, he replied: 'I should be afraid of disappointing you every way'. [NLS: MS. 10706/16]



Rennie's cycloidal curves as implemented to the 42ft diameter base, checked by the editor and Robert Mackay NLB Civil Engineer when the helicopter pad was being constructed in 1986.

Appendix B

Extract from Rennie's letter of 13 February 1807 to Stevenson specifying the base diameter and curvature of the lower part of the lighthouse tower as it was incorporated into the working drawings and implemented. [NLS: MS. Acc. 10706/63, 65.]

... I have sketched out a new plan for the [Bell Rock] Light house & I trust this will give you satisfaction. The first or lower course of stones forms a circle of 42 feet dia[mete]r, the second course 38 feet, the third 35, the fourth 33 & the fifth 32, forming by these dimensions a cycloidall base which under all circumstances seems the best. I hope the plans* will be ready by the end of next week when they shall be forwarded to you.

* Only one of these drawings (there may have only been one) appears to have survived, dated 21 February 1807 – an outline of the base and tower. Stevenson was anxious to get these details quickly in order to proceed with the working drawings and moulds of undressed stone sizes for the quarriers, and he requested an outline from Rennie on 14 February 1807 [NLS: MS. 19806/19.] Soon after this, as their letters crossed in the post, Stevenson would have received Rennie's letter fixing the base diameter at 42ft and the lower tower curvature. Details of any other Rennie plans and instructions sent about this time may never be known as his letter to Stevenson of 23 February, which possibly accompanied the plans, is missing from its letter-book in the Stevenson archive. The other possible source, Rennie's outgoing letter books for 1807–13 with copies of his letters to Stevenson, is not to be found at the National Library of Scotland or the Institution of Civil Engineers and may no longer exist.

Despite the urgency for David Logan to prepare the working drawings under Stevenson's direction, it was to be about 15 months before the first entire course of 123 stones was assembled on the work-yard platform at Arbroath ready for shipping out to the rock. This was largely because of the difficulty of obtaining granite blocks of the size and quality required from Aberdeen.



*Commissioners of Northern Lighthouses Aids to Navigation 2010
(updated from 2, 168) ©CollinsBartholomew Ltd 2010*