

John Scott Russell (1808-1882) - in the same league as Stephenson and Brunel?

All Exhibits are from the Archives of the Institution of Civil Engineers

Case 1: THE GREAT WAVE

John Scott Russell was interim Professor of Natural Philosophy at the University of Edinburgh at the age of 23, but did not gain tenure. His academic background was to stay with him as his engineering career developed. His first major project was a fleet of steam carriages whose operations were sabotaged by road trustees. Hydrodynamics and naval architecture became his life-long interest. His introduction to shipbuilding began with experimental vessels for use on Scottish canals. By 1838 he was a pioneering project manager introducing steam power and iron hulls for ocean-going vessels at Caird's shipyard in Greenock. He published extensively about the novel technology of steamships. His experiments led to the discovery of the soliton, the great solitary wave.

Exhibits:

- 1.1 Russell's steam carriage. *Mechanics' Magazine*. Vol.21, no.556, p.15 (5 April 1834).
- 1.2 RUSSELL, John Scott. Two manuscript letters to T. Deans, Solicitor, of London, relating to Patent Specifications of Steam Carriages. Edinburgh : -, 1834
- 1.3 Russell's steam carriage engine and boiler. *Mechanics' Magazine*. Vol.22, no.603, p.385 (28 February 1835).
- 1.4 RUSSELL, John Scott. *A Treatise on the Steam-Engine*. Edinburgh : Black, 1841. [reprinted from the supplement to the 7th edition of the *Encyclopaedia Britannica*].
- 1.5 MACNEILL, John Benjamin. Recent canal boat experiments. *Transactions of the Institution of Civil Engineers*. Vol.1, pp.237-284 (1836).
- 1.6 RUSSELL, John Scott. Researches in hydrodynamics. Edinburgh : Neill, 1837 [reprinted from the *Transactions of the Royal Society of Edinburgh*].
- 1.7 [RUSSELL, John Scott](#). Letter on the improvement of the River Dee, and port and harbour of Chester. Chester : -, 1838.

Side-panels:

- 1.a RUSSELL, John Scott. On the vibration of suspension bridges and other structures, and the means of preventing injury from this cause. *Transactions of Royal Scottish Society of Arts*, 1841, I, pp.304-314.

Case 2 - THE GREAT SOCIETIES

John Scott Russell's discovery of the soliton was one of a number of mechanical phenomena which he described at the meetings of the British Association. Others included wave motion, tidal phenomena and the design of sea-walls and embankments. He frequented the meetings of learned societies in Scotland, which he continued after moving to London. He was soon secretary of the Society of Arts and four years later was elected a Fellow of the Royal Society. In 1844 he began contributing to the weekly *Railway Chronicle* and became railway editor on Charles Dickens' new *Daily News* – until the railway boom ended in 1847. Throughout the later 1840s the Society of Arts proposed a national industrial exhibition, a project which interested its honorary president, Prince Albert.

Exhibits:

- 2.1 RUSSELL, John Scott. Notice of the reduction of an anomalous fact in hydrodynamics, and of a new law of the resistance of fluids to the motion of floating bodies. *Report British Association*, 1834, pp.531-534.
- 2.2 RUSSELL, John Scott. 'On the law which governs the resistance to motion of railway trains at high velocities.' *Report British Association*, 1846 - part 2, pp.109-111.
- 2.3 [RUSSELL, John Scott](#) and ROBISON, Sir John. *Report of the Committee on Waves, appointed by the British Association at Bristol in 1836*. London: R. & J.E. Taylor, 1838.
- 2.4 [RUSSELL, John Scott](#). *Reports on Waves made to the meetings of the British Association in 1842-43*. London : -, 1845.
- 2.5 RUSSELL, John Scott. On certain effects produced on sound by the rapid motion of the observer. *Report British Association*, 1848 - part 2, pp.37-38.

Case 3 - THE GREAT EXHIBITION

John Scott Russell was a promoter and the "indefatigable Secretary" to the Great Exhibition of 1851. Scott Russell recruited the ambitious Henry Cole to help with the venture. In October 1851 both Scott Russell and Henry Cole received letters hand-written by Prince Albert in appreciation of the incredible success of the Great Exhibition. Charles Dickens later featured Cole as the pugilistic Government Inspector of

Industrial Schools in Hard Times (1854). Henry Cole went on to create the Victoria and Albert Museum, while Scott Russell returned to engineering and ship-building.

Exhibits:

- 3.1 WYATT, Matthew Digby. *On the Construction of the Great Exhibition building*. in ROYAL COMMISSION FOR THE EXHIBITION OF THE WORKS OF INDUSTRY OF ALL NATIONS 1851 *Great Exhibition of the Works of Industry of all Nations 1851. Official descriptive and illustrated catalogue*. Vol. 1. London : Spicer Brothers, 1851.
- 3.2 DOWNES, Charles and COWPER, Charles *The Building erected in Hyde Park for the Great Exhibition of the works of industries of all nations*. London: J. Weale.. 1852 (1971 reprint).
- 3.3 WYATT, Matthew Digby. *The Construction of the building [of the Great Exhibition of 1851]* London : -, 1851 Extract from the Exhibition catalogue.
- 3.4 ROYAL COMMISSIONERS FOR THE EXHIBITION OF 1851 *First report of the commissioners for the exhibition of 1851*. London : W Clowes & Sons, 1852.
- 3.5 RUSSELL, John Scott. Contribution to debate, pp.170-172 on paper – WYATT, Matthew Digby. On the Construction of the building for the Exhibition of the works of industries of all nations of 1851. *Minutes of Proceedings of the Institution of Civil Engineers*. Vol.10, pp.162-223 (1851)

Case 4: THE GREAT SHIP

John Scott Russell was invited to join a shipbuilding venture using the site vacated by William Fairbairn on the Isle of Dogs in 1847. In the following five years Scott Russell designed and supervised the building of small, but novel, iron-hulled vessels, including the schooner-yacht “*Titania*” for fellow ICE member Robert Stephenson. Scott Russell also worked with I. K. Brunel on two successful ocean mail steamers, “*Victoria*” and “*Adelaide*”, for the Australia run. Brunel then proposed a massive ship for the London-Calcutta run. Scott Russell was responsible for its hull form, structure and machinery. Brunel meddled in these details, but ignored Scott Russell’s advice on launching the heavy hull. The strongly-built hull cost £562,000 and another £170,000 to launch. The “*Great Eastern*” project damaged both men and led to the Brunel family’s continuing grievance against Russell.

Exhibits:

- 4.1 RUSSELL, John Scott. The wave-line principles of ship construction: Parts I & 2. *Transactions of the Institution of Naval Architects*. Vol.1, pp.184-211 (1860).
- 4.2 RUSSELL, John Scott. The late Mr. John Wood and Charles Wood, naval architects, Port Glasgow. *Transactions of the Institution of Naval Architects*. Vol.2, pp.141-148 (1861).
- 4.3 RUSSELL, John Scott. *The Modern System of Naval Architecture*. Vol. II London : Day, 1865. includes Plate 20: Structure of an Iron Ship built on the system of transverse frames. This shows the strength of construction for a 845-ton screw-clipper built with transverse frames with iron longitudinals added. The system was scaled-up with added longitudinal bulkheads for the 3000-ton “*Victoria*” and “*Adelaide*”. This system was combined with longitudinal framing for the strong hull of the 20000-ton “*Great Eastern*”.

Case 5 -: THE GREAT INSTITUTIONS

John Scott Russell was elected to membership of the Institution of Civil Engineers in 1847 and was also elected a member of the newly formed Institution of Mechanical Engineers in the same year. He had attended the Tuesday meetings of the ICE from his arrival in London. For twenty years his contributions to over sixty papers are recorded in the Minutes of Proceedings exchanging views with Stephenson, Brunel, Rennie, Bidder and others. The Institution of Naval Architects was the third British engineering institution. Sir William White, a later President of both INA and ICE, credited its successful formation in 1860 to Scott Russell “as someone familiar with the working of another great technical association to bring such wishes to a living issue”. Scott Russell was a Vice-President of the INA from its inception to his death. At the ICE he was elected a Member of Council in 1857 and was a Vice-President from 1862 to 1867.

Exhibits:

- 5.1 RUSSELL, John Scott. On the practical forms of breakwaters, sea-walls, and other engineering works, exposed to the action of waves. Paper No.755. *Minutes of Proceedings of the Institution of Civil Engineers*. Vol.6, pp.135-148 (9 March 1847).
- 5.2 RUSSELL, John Scott. On the practical forms of engineering works exposed to the action of the waves of the sea, and on the advantages and disadvantages of certain forms of construction for breakwaters and sea-walls. *Journal of the Franklin Institute*, Vol.14, pp.13-15 (1847). – summary of 5.1.
- 5.3 RUSSELL, John Scott. The education of naval architects in England and France. *Transactions of the Institution of Naval Architects*. Vol.4, pp. 163-185 (1863).
- 5.4 RUSSELL, John Scott. *The Modern System of Naval Architecture*. Vol. I. London: Day, 1865: includes as Chapter 23, *The Wave Principle of Least Resistance*, in which he repeats the description of the

soliton at the foot of p.213 "This is a most beautiful and extraordinary phenomenon: the first day I saw it was the happiest day of my life.

- 5.5 [RUSSELL, John Scott](#) On the application of the inventions of Watt to modern Steam Navigation. *Papers of Greenock Philosophical Society*, No. 3. (1867).

Side-panels:

- 5.a RUSSELL, John Scott. Contribution to debate, pp.212-213, 221-222 on paper – REDMAN, John Baldry. On the alluvial formations and the local changes of the south coast of England. *Minutes of Proceedings of the Institution of Civil Engineers*. Vol.11, pp.162-223 (20 January 1852)
- 5.b RUSSELL, John Scott. Contributions to debate pp.530, 531, 534 on paper – HAYTER, Harrison. The Charing Cross Bridge. *Minutes of Proceedings of the Institution of Civil Engineers*. Vol.22, pp.512- 539 (28 April 1863).
- 5.c RUSSELL, John Scott. Contributions to debate pp.596, 601-602 on paper – WATSON, William. On the communication between London and Dublin. *Minutes of Proceedings of the Institution of Civil Engineers*. Vol.22, pp.574- 603 (12 May 1863).
- 5.d RUSSELL, John Scott. Contribution to debate p.184 on paper – HEPPEL, John Mortimer. On the closing of reclamation banks. *Minutes of Proceedings of the Institution of Civil Engineers*. Vol.23, p.168-185 (12 January 1864).
- 5.e RUSSELL, John Scott. Contributions to debate pp.236-237 on paper – REDMAN, John Baldry. The East coast between the Thames and the Wash estuaries. *Minutes of Proceedings of the Institution of Civil Engineers*. Vol.23, p.185-256 (26 January 1864).
- 5.f RUSSELL, John Scott. Contributions to debate p.318-319 on paper – SOPWITH, Thomas. The state of the works on the Mont Cenis Tunnel and description of the machinery employed. *Minutes of Proceedings of the Institution of Civil Engineers*. Vol.23, pp.258-319 (16 February 1864).
- 5.g RUSSELL, John Scott. Contributions to debate on cofferdam p.59 on paper - CLARK, Edward Hele. Great Grimsby (Royal) Docks. *Minutes of Proceedings of the Institution of Civil Engineers*.Vol.24, pp.38-61 (29 November 1864).
- 5.h RUSSELL, John Scott. Contributions to debate on action of groynes or jetties on River Clyde and River Dee, Chester, pp.86-91, and improvement of rivers, by straightening them, p.100. TAYLOR, Joseph. Description of the River Tees and of the works upon it connected with the navigation. *Minutes of Proceedings of the Institution of Civil Engineers*. Vol.24, pp.62 – 103 (6 December 1864).
- 5.i RUSSELL, John Scott. Contributions to debate on hydraulic-lift versus ordinary graving and floating docks and slips or inclined planes pp. 311-312, 345-347 on paper – CLARK, Edwin. The hydraulic-lift graving dock. *Minutes of Proceedings of the Institution of Civil Engineers*. Vol.25, pp.292- 352 (27 February 1866).

Case 6 - THE GREAT BOOK

John Scott Russell published widely on both naval and merchant shipping. His pedantic instinct and predilection for large ventures combined in one of the largest technical monographs ever published: The Modern System of Naval Architecture, Its three volumes weigh over 25kg and in 1865 the author was offering it for sale at 30 guineas, the equivalent of over £2500 today. Its beauty has ensured most copies have survived, but its cost limited both its sales and its public. By the time the Great Book was published Scott Russell's business was suffering from the slump and he began to use unsold copies as security for his outstanding debts.

Exhibits:

- 6.1 [RUSSELL, John Scott](#). *The Modern System of Naval Architecture*. Vol. III. London: Day, 1865: includes as Plate 105: Launch of "Great Eastern" [scale: 1in 192}. This volume also includes as Plate 95, a longitudinal profile of the structure of "Great Eastern" at 1 in 96 scale it cannot be laid flat in this case.

Case 7: THE GREAT ARMOURER

John Scott Russell was well-connected with both sides in the American Civil War. The representative of the State of Massachusetts sought the heaviest guns available to defend Boston from Confederate raiders. The greatest armourer of all was Sir William Armstrong. George Bernard Shaw gave the following words to his fictional counterpart, Andrew Undershaft: "*I am the government of your country. You will make war when it suits us, and keep peace when it doesn't. You will discover that my want is a national need.*" Scott Russell steered the Massachusetts enquiry to Armstrong and was paid a commission. Armstrong failed to deliver the guns before the war was over and was not paid. He sought his fee back from Russell, who was also suffering from the slump following the war. Armstrong was offered the unsold copies of the Great Book, only to find that there was a lien on them from its bankrupt printer. This commercial dispute was used by Russell's rivals egged on by Brunel's family to oust him from ICE's Council shortly before he was due to become President. The resulting muddle found Sir John Fowler and Zerah Colburn's "*Engineering*" in support of Russell, while "*The Engineer*" kept on the right

side of Lord Armstrong. All the principal personalities involved are described in the “*Biographical Dictionary of Civil Engineers, Volume 2 – 1830 to 1890*”.

Exhibits:

- 7.1 RUSSELL, John Scott *The Fleet of the future : iron or wood ? Containing a reply to some conclusions of General Sir Howard Douglas in favour of wooden walls.* London: Longman, Green, etc... 1861. This is typical of John Scott Russell’s inability to suffer fools gladly and illustrates how in pursuit of what he regarded as self-evident he would antagonize many highly-placed established individuals.
- 7.2 HOLLEY, Alexander Lyman. *Treatise on ordnance and armor.* New York : Van Nostrand, 1865. This describes Armstrong’s extraordinary relationship with the UK government.
- 7.3 Institution of Civil Engineers Archives, Registry Papers, No.208 (1866-67) original correspondence concerning the inquiry into allegations made against John Scott Russell. This includes initial manuscript letters from I. K. Brunel’s elder son to the ICE Secretary and subsequent correspondence, which have all the outward appearances of a conspiracy. The subsequent manuscripts of Council Minutes can at best be described as muddled in their approach. - The full weight of Armstrong’s influence is apparent in the solitary printed monograph of his grievances – prepared as if by the ICE - see 7.4.
- 7.4 Sir W G Armstrong & Co and Mr J Scott Russell: correspondence and documents submitted to, with minutes of evidence taken before the Council of the Institution of Civil Engineers. London, 1867
- 7.5 KIRKALDY, David *Preliminary report to the Steel Committee of the Institution of Civil Engineers: 1868.* (The committee consisted of W.H.Barlow, Sir John Fowler, John Scott Russell, Captain Galton and Sir George Berkley.)
- 7.6 CROSS-RUDKIN, P.S.M., CHRIMES, M. M., et al. (eds.) *Biographical Dictionary of Civil Engineers, Volume 2 – 1830 to 1890.* London: Thomas Telford. 2008.

Side-panels:

- 7.a Various editorials from “*Engineering*” and “*The Engineer*” (1866-68)

Case 8 - THE GREAT ROOF

John Scott Russell’s prestige was undamaged by the setback to his ambition to become President and he continued his subscription to ICE throughout his life. He resumed his career as an engineering consultant. He designed an innovative shallow draught train ferry for Lake Constance. In 1871 his suggestion for a riveted iron-plate cone stiffened by tapering radial ribs and concentric iron rings was chosen by the Imperial Commission of the 1873 International Exhibition of the Austrian Empire for the Vienna Rotunda – the largest roof in the world for a decade. By the mid-1870s he resumed contributing to the debates at the Institution of Civil Engineers. He was revising his ideas on waves for a book, which was published after his death. His obituary appeared in the principal engineering journals including 13 pages in the Minutes of Proceedings of the Institution of Civil Engineers. On the centenary of the Royal Institution of Naval Architects in 1960, its historian wrote : “It seems to have become a fashion to belittle and malign Scott Russell with the apparent object of increasing the fame of that very eccentric genius Isambard Brunel.”

Exhibits:

- 8.1 RUSSELL, John Scott. *Systematic technical education for the English people.* London : Bradbury, Evans, 1869 CASE 8
- 8.2 RUSSELL, John Scott. International communication between England and Europe by special harbours and train steamers. *Transactions of the Institution of Naval Architects.* Vol.13, pp. 213-228 (March 1872).
- 8.5 The Vienna Exhibition of 1873, no.IV. *Engineering*, Vol. 15, pp. 159-161 (7 March 1873).
- 8.4 RUSSELL, John Scott. The wave of translation and the work it does as the carrier wave of sound. *Proceedings of the Royal Society London*, Vol.32, pp.382-383 (1881).
- 8.5 RUSSELL, John Scott. *The Waves of Translation in the Oceans of Water, Air and Ether.* London : Trubner, 1885
- 8.6 Obituary of John Scott Russell. *Transactions of the Institution of Naval Architects*, Vol.23, 258-261. (1882)

Side-Panels:

- 8.a MAW, William Henry, and DREDGE, James, Jnr. Vienna Universal Exhibition of 1873, no.IV. *Engineering*, Vol. 15, p. 159-161 (7 March 1873).