

Mr. Rastrick possessed great vigour and strong determination of character; opposition and difficulties only roused him to greater efforts. He was a man of unremitting application, and he has been known to devote whole nights, as well as days, to the careful consideration of the details of his works, with an energy and minuteness that would have worn out many of his juniors, upon whom his example produced excellent effect, and he was always regarded by his principal assistants with feelings of the highest regard and respect.

He joined the Institution as a Member in the year 1827, and was also a Fellow of the Royal Society, and a Member of the Society of Arts.

He retired from the active duties of the profession about the end of the year 1847, and died on the 1st day of November, 1856, at his residence, Sayes Court, near Chertsey, Surrey, in the 77th year of his age, and was buried in the new cemetery at Brighton. Although old age had enfeebled his bodily frame, yet he evinced, even up to the last moment of his existence, the same indomitable energy and clearness of intellect, for which he had always been so remarkable.

Mr. JAMES MEADOWS RENDEL was born in the winter of the year 1799, near Oakhampton, on the borders of Dartmoor, in Devonshire. He was the only son of a country surveyor and farmer, and the grandson of Mr. Meadows, F.R.S., a well-known architect of his day. His Father was a man of more than ordinary stature and massive frame, with a very intelligent face; plain in manners, and reserved in conversation, but conveying the impression, that he possessed an excellent judgment and a well-regulated mind; whilst to his mother, who was a woman of considerable acquirements, he owed the rudiments of his early education. He passed his youth in the neighbourhood of Teignmouth, receiving his education at a country school, and being initiated into the practical operations of a millwright, with his Uncle, who resided there, whilst from his Father, who had charge of a district of roads, &c., he obtained a certain degree of familiarity with the rudiments of Civil Engineering.

At an early age he went to London, and obtained an engagement, as a surveyor, under the late Mr. Telford, by whom he was employed on the surveys and experiments for the proposed suspension bridge across the Mersey, at Runcorn. About the year 1822, he settled at Plymouth, and commenced practice on his own account, being then chiefly employed in the construction of roads, in the north of Devon. In September of that year, having designed a suspension bridge for crossing the Tamar, at Saltash, he

came under the notice of the late Earl of Morley. With that quickness which characterized his lordship in all matters of business, he suggested the applicability of the principle to the construction of a bridge across the Catwater, an estuary of the Plym, within the harbour of Plymouth, at Lary. The drawings having been made and approved, an Act of Parliament was obtained in 1823; but in the following year it was repealed, so far as related to the suspension bridge, and the powers were extended, authorizing the erection of the present structure. Lord Morley's penetration enabled him to perceive the powers of the young Engineer, and after satisfying himself, by application to Mr. Telford, of the correctness of his opinion, he intrusted to Mr. Rendel, then only twenty-five years of age, the execution of this work, which he knew to be one full of difficulty and risk. Events justified the soundness of his lordship's judgment; and the generosity with which Mr. Rendel was shielded from all interference, made him feel that, in spite of his youth, entire confidence was placed in him. This was so gratifying to his susceptible temperament, that the anxious superintendence of the works became a labour of love. At that time the communication between the opposite banks was carried on by means of a ferry-boat, which, from its peculiar construction, was called "The Flying Bridge," and had been established by the Earl of Morley, as proprietor of the ancient ferry, between Oreston and Cattedown. The new bridge consisted of five elliptical arches of cast iron, springing from abutments and piers of stone-work. From the loose description of the soil forming the bed of the river, considerable skill was required in securing the foundations of the bridge, from the undermining effects of the current, the rapidity of which was very considerable. This danger was effectually guarded against by Mr. Rendel, by the formation of an artificial bottom extending from 60 feet above to 70 feet below the bridge. In levelling the pile-heads, and paving the spaces between them, in order to make a firm basis for the piers, a wooden diving-bell was used, into which the light was admitted through lenses fixed in the top. The works were commenced in August, 1824; the first stone was laid on the 26th of March, 1825, and the bridge was opened on the 14th of July, 1827. The cost of the works was £27,126. This bridge was, with the exception of that of Southwark, the largest that had hitherto been constructed of iron. Mr. Rendel presented a full description of the works to the Institution: this was published in the first volume of the Transactions,¹ and for it, he received a Telford medal.

Whilst the Lary Bridge was being constructed, an accident oc-

¹ *Vide Transactions Inst. C.E., vol. i., pp. 99 to 108. Also Trans. of Plymouth Inst., vol. i. (1830).*

curred, which proved nearly fatal to Mr. Rendel. He fell off the scaffolding into the sea, and, being encumbered with a heavy coat and jack boots, he was submerged for some time before being rescued. The little glimmering of life that remained was fast being extinguished, by the exposure and injudicious treatment of the bystanders, when, most fortunately, Dr. Cookworthy arrived, and after using protracted efforts, aided by the devices of medical science, he succeeded in restoring the latent spark of life. The most cordial friendship ever afterwards subsisted between Dr. Cookworthy and Mr. Rendel, in which their families participated. An interesting feature of this accident was, that Mr. Rendel, whilst under the water, experienced the most vivid retrospect of every circumstance of his previous life, with a minuteness and fidelity perfectly marvellous.

In the year 1826, Mr. Rendel constructed the Boucombe Bridge, where hydraulic power was first applied to the machinery for working swing bridges. Soon after the completion of the Lary Bridge, he constructed, for Lord Morley, some roads, the Cann Quarry Tramway, and a sluice of peculiar construction at the Chelson Meadows.¹ He also made several turnpike roads, including the southern route between Plymouth and Totness, the road from Plymouth to Cornwall, *via* Saltash,² and the road from Devonport to Liskeard, *via* Torpoint; and in connection with one of these roads, he designed and superintended the construction of a bridge over the creeks, at Kingsbridge.

In the year 1831, he introduced a new system of crossing rivers, by means of chain ferries worked by steam power, and in 1832, a floating bridge was constructed by him on this principle, for crossing the Dart, at Dartmouth. In 1832-34, similar floating steam bridges were established at Torpoint and Saltash, across the Tamar, which have proved of considerable utility to the neighbourhood, by the facilities they afford, for passing to and from Devon and Cornwall. Prior to their establishment, the only means of communication was by ordinary ferry boats; now vehicles, horses, and passengers, are conveyed across without any inconvenience. The account of this bridge was laid, by Mr. Rendel, before the Institution in 1838, and was published in the Transactions.³ For this the Council again awarded to Mr. Rendel, the Telford Medal, the highest acknowledgement in their power, accompanied by a suitable record, of the sense entertained of the benefit conferred by him on the inland navigation of the country, in overcoming the difficulties of crossing rapid tideways. He afterwards designed

¹ *Vide* Minutes of Proceedings Inst. C.E., vol. ii. (1842), pp. 62 and 63.

² *Vide* "A Report to the Subscribers to a Survey of proposed Turnpike Road from Plymouth to St. Austell." Tract. Folio. Plates. Plymouth, 1835.

³ *Vide* Minutes of Proceedings Inst. C.E., vol. i. (1838), pp. 21-24; and Transactions, vol. ii., pp. 213-227.

bridges of a similar character for crossing the Itchen at Southampton, and for passing between Gosport and Portsmouth. The rapid introduction of the railway system prevented, however, a further development of this useful system of crossing rivers. He was also engaged in the endeavour to establish similar bridges over the river Hooghly, at Calcutta, and about the year 1838, he was consulted as to the feasibility of establishing this description of ferry over the river Severn, at Newnham.

During this period, Mr. Rendel was further engaged in examining and reporting upon the improvement of almost every harbour and river in the South West of England, and then acquired that mastery of what is termed hydraulic engineering, on which his fame will chiefly rest. Thus, in 1829, he designed the harbour, which has since been executed, at Par, in Cornwall; in 1835, he designed and carried out works in connection with the Bude harbour, dock and canal; in 1836, he designed the Brixham harbour and breakwater at Torbay,¹ for which an Act was obtained, also works connected with the port of Exmouth, in Devonshire, which latter were executed; in 1836-7, he reported to the Post-office authorities, on the practicability of building bridges across the river Severn at Aust and New Passages; and designed the Millbay Docks, now executing by Mr. I. K. Brunel, V.P. Inst. C.E., as a terminus to the Western railways; in 1837, he designed an extensive harbour at Helston, in Cornwall,² and the restoration of Southampton pier; in 1838, a harbour for Poole, in Dorsetshire; and the Gosport dock and pier, the latter of which was executed; in 1840, he designed improvements and new docks in the port of Hull, and reported on the proposed steam-packet harbour and docks at Portsmouth,³ and on Sir John Rennie's plan for embanking the shores of the Great Wash;⁴ in 1841, the harbour of Polpero, in Cornwall, and river walls on the Avon, near Bristol; in 1843, improvements for the port of Harwich, and for Swansea harbour; in 1843-4, he constructed canals in Devonshire, and was engaged on the Colchester and Arundel Navigation; and in 1844, he designed harbour improvements for Newhaven and Little Hampton, in Sussex. During this period he was employed by the Admiralty, and other Government Departments, as well as by public companies, on various matters connected with rivers, harbours, docks and other marine works. In all cases he was engaged

¹ *Vide* "Report and Plans for a Breakwater at Brixham, in Torbay." Tract. Folio. Plates. London, 1836.

² *Vide* "Report on the Practicability of forming a Harbour at the Mouth of the Loe Pool, in Mount's Bay, near Helston, in the County of Cornwall." Tract. 4to. vol. xxxiv. Plans. Plymouth, 1837.

³ *Vide* "Report on the proposed Steam-Packet Harbour and Docks in the Port of Portsmouth." Tract. 8vo. vol. lxxv. Plan. London, 1840.

⁴ *Vide* "Report on the Plan of Sir J. Rennie, for Embanking the Shores of the Great Wash." Tract. 8vo. vol. lxxiv. Plan. London, 1840.

professionally, and in none was he the projector. He was also much employed, about this time, by the Exchequer Loan Commissioners, and especially, in 1835-7, in the repair of the Montrose Suspension Bridge,¹ after its fall, where he introduced the principle of trussing the framing of the roadway, which is now acknowledged to be so necessary, to insure the safety of such structures, by preventing the undulation by which so many have been destroyed.

About the year 1838, Mr. Rendel removed to London, leaving Mr. Beardmore, M. Inst. C.E., as his partner at Plymouth. He soon became extensively occupied on important works, and was engaged in the Parliamentary contests of that remarkable period in the history of engineering. The works executed in the neighbourhood of Plymouth about this time, were, from 1835 to 1842, the improvement of the Devonport Water Company's service reservoirs and distributing mains, for the supply of water to the town, the dockyard and the public departments; and in 1841, the construction of the Millbay pier, in a small tidal basin at the top of Millbay, Plymouth. This pier was the precursor of the Great Western Docks, and was a work of considerable difficulty, owing to the great depth of water in which it was built. Here he first introduced the method of construction, since employed with so much success, at the great harbours of Holyhead and Portland.

In 1835-36, he projected several routes through the South of Devon, with the view of extending the Bristol and Exeter Railway to Plymouth. In 1839, he was engaged, at the instance of the projectors, in preparing various schemes for an inland line of railway between Exeter and Plymouth, over Dartmoor, where the character of the district rendered necessary works of considerable magnitude, and demanded great skill and judgment on the part of the Engineer. The funds of the district were, however, insufficient for so large a work, and the railway was afterwards constructed, in conjunction with the Great Western Company, and by their Engineer, Mr. I. K. Brunel, V.P. Inst. C.E.

In the year 1843, Mr. Rendel became connected with the projectors of the Birkenhead Docks, his plans for which, whether they are ever completely executed, or not, will always be remarkable in the annals of engineering, for the praise and condemnation which they have alternately received, as well as for the extraordinary ability and success with which Mr. Rendel defended them, before numerous Committees of both Houses of Parliament, against the united influence of parties both at Liverpool and at Birkenhead.² The design for these Docks brought Mr. Rendel

¹ *Vide Minutes of Proceedings Inst. C.E., vol. i. (1841), pp. 122-9.*

² Since this was written, an Act has been passed, transferring the Liverpool and Birkenhead Docks to a new Trust, representing all parties interested in the

very prominently before the world, and the protracted contests on this subject will not only be long remembered, in the history of Parliamentary Committees, but the evidence given by him and other Engineers, as now collected, forms a valuable record of the state of engineering practice. The almost incessant labour, and the mental anxiety inseparable from this undertaking, were, however, more than even his powerful constitution could support, and it is feared that they tended to shorten his valuable life.

These hydraulic works were followed by many others, and Mr. Rendel has since constructed, in 1844-53, the new docks of Grimsby; in 1848-53, extensions of the docks at Leith, including a new steam-dock; in 1850-53, docks at Garston, on the Mersey, for the St. Helen's Canal and Railway Company; a new junction dock and other works, for the East and West India Dock Company; and a new basin with dock and river entrances of a very large size for the London Dock Company in the Thames (now in progress). With regard to the Grimsby Docks, it should be remembered, that the works were projected far out upon the mud banks of the river Humber, entirely beyond low-water mark,—that great difficulties were encountered in laying the foundations, owing to the treacherous nature of the substratum,—that the dock walls were executed in a novel manner, and yet, notwithstanding, the whole works were most successfully accomplished. Here, Mr. Rendel led the way in the application of the comprehensive system of hydraulic machinery, for working the lock-gates, sluices, cranes, &c., invented by Mr. W. G. Armstrong, M. Inst. C.E. For this work he received a Grand Medal of Honour from the Paris Universal Exhibition, of 1855. In a discussion at the Institution, in 1849,¹ on the preliminary works for these docks, Mr. Rendel thus expressed himself, as to the profession of an Engineer:—

“He was well aware how much Engineers had to learn, and how valuable an accurate knowledge of geology must be to them; but he assured the Reverend Dean (of Westminster, Dr. Buckland,) that, as a body, they were not so ill-informed as had been assumed, and that those who were anxious for the success of their works, adopted more precautions than he appeared to be aware of. They fully appreciated the necessity of a knowledge of geology, and although they might not be able to discourse upon it, with the eloquence of a Buckland, a Lyell, or a Sedgwick—to prosecute a

Mersey. A clause of this Act enacts that the works as designed by Mr. Rendel, and authorized by Parliament, shall be executed in the shortest possible time. Mr. Rendel's decease having taken place prior to the passing of this Act, the credit of this particular clause belongs, mainly, to the exertions of Mr. Brunel, (V.P. Inst. C.E.), acting on the part of the Great Western Railway Company.

¹ *Vide Minutes of Proceedings Inst. C.E., vol. ix., pp. 1 to 23.*

microscopic investigation, with the discrimination of Owen, or Mantell, or to speculate so plausibly on the events of past ages, as were those eminent professors,—no careful Engineer decided upon the position, or mode of construction, of his works, without a series of trial borings, a careful examination of the specimens, and experiments upon them, with a view to ascertain their properties, and their capability for sustaining weights. Instead of accusing Engineers of knowing so little, it was rather a subject of surprise that they knew so much, when it was considered how much they were required to mix in the active business of life; and he considered that no other profession demanded such varied acquirements, or the exercise of such general common sense and judgment.”

He also reported on and examined, at various times, most of the principal docks in the kingdom, including, amongst others, those at Cardiff, Hartlepool, Sunderland, and the Victoria (London) Docks.

About the year 1844, Mr. Rendel was engaged on the Edinburgh Water Works, and from 1846 to 1852, he acted as Consulting Engineer for the Company. The works of the extensions were executed under the immediate direction of Mr. J. Leslie, (M. Inst. C.E.). In 1853, he reported to the Corporation of Leeds, on the supply of water to that borough, and suggested plans for its improvement.

In the year 1845, he was employed, with other Engineers, by the Admiralty, in reference to the great Packet and Refuge Harbour of Holyhead, and his plan being selected, he was intrusted with its execution. In 1846-7, he constructed a graving dock at the old harbour there. In the year 1847, he was also intrusted with the Harbour of Refuge, at Portland. Both these works have hitherto progressed in the most rapid, successful, and gratifying manner; and even if he had done little more, they alone would suffice to hand down his name to posterity, beside those of Smeaton, Rennie, and Telford. They were conceived with the largest views. In both cases the system adopted was to deposit the masses of stone, of all dimensions, vertically from railway waggons, running on fixed timber staging, instead of employing the old system of dropping the stone from barges, or of running out a bank from the shore, and tipping the materials over the end and sides, allowing the waves to impinge with all their force upon the mass, before it had time to become consolidated. By this new system the mass was brought up simultaneously, to above the level of the sea, the utmost force of which it withstood with ease. In this manner, as much as 24,000 tons of stone have been deposited in one week, whilst to supply this vast demand, monster blasts of 5, or 6 tons of gunpowder were frequently employed. It is worthy of remark, that, although the severe storms which have repeatedly occurred on the exposed coasts where they are situated,

have done some injury to portions of the stages, and of the temporary works at Holyhead, not a stone would appear to have been carried away from the jetties at either place, and none of the pile standards of the stages at Portland, where they are secured into the ground by Mitchell's screw-pile shoes, have been moved. The success of the system may therefore be said to be complete, in spite of the sinister predictions which prevailed before it was tried.

Mr. Rendel also designed, about the year 1850, and up to his death superintended the construction of, the new harbour at St. Peter Port, Guernsey, and, had he lived, would have constructed the new Harbour of Refuge at Hartlepool, for which an Act was obtained in the year 1855. There is, indeed, scarcely a harbour in the kingdom on which he has not reported, either to the public, or private bodies having their direction. Of those not otherwise noted, mention may be particularly made of the harbours of Ardglass, Chichester, Langston, Lowestoft, Montrose, Peil, Scrimmerston, Wells, and Wexford; and of Port Carlisle. Again in 1844, he made a design for a harbour at Margate; in 1845, his plan for the Dover Asylum Harbour was the one selected by the Royal Commission, although it was not ultimately adopted; in 1848, he designed improvements in the Devonport Dockyard, which have since been carried out by the officers of the Admiralty Works Department; in 1852, he proposed the extension of Wick Harbour, and gave designs for a steam-ship harbour and dock in the river Avon, at Kings Road (Bristol); in 1853-4, he designed the extension of the port of Whitehaven, and a floating dock and other works at Maryport; and in 1854, he reported on Kingstown Harbour of Refuge, with a view of affording increased steam-packet accommodation, and also on a project for a harbour of refuge and commercial basin, at Table Bay, Cape of Good Hope.

He was also much engaged in the improvement of rivers, and especially reported on the rivers Thames, Severn, Tay, Tyne, Lea, Ouse and Nene, the works for the latter of which, extending from Northampton to Wisbeach, with a view both to navigation and drainage, are now in course of construction. He was likewise consulted as to the Norwich and Yarmouth navigation, and the Wye drainage and navigation. In 1846, he designed docks and river improvements for the port of Lynn, portions of which have been executed. In 1852, in conjunction with Sir William Cubitt, M. Inst. C.E., and Mr. Griffith, M. Inst. C.E., he examined and reported to the Treasury upon the Arterial Drainage Works in Ireland. And in 1853-6, he directed the surveys of the river Kowie, Cape of Good Hope, and reported on measures for its improvement.

In 1854, he reported upon a project for a suspension bridge across the Hooghly, at Calcutta; and in 1855, he completed the new sus-

pension bridge across the Ness at Inverness, for the Commissioners of Highland Roads and Bridges.

The fame of Mr. Rendel as a Hydraulic Engineer, naturally attracted the attention of foreign countries, and he was employed by the Sardinian, the Brazilian, and the Prussian Governments, and the Senate of Hamburg. In 1852-3, he designed docks and other works in the port of Genoa, and in 1854, he was authorized to proceed with the detailed drawings; and the execution of his plan only awaited the return of a more favourable monetary period. He likewise designed a Naval Arsenal in the gulf of Spezia. In 1853-5, he reported on the proposed harbour works at Rio de Janeiro, now constructing under the direction of his former pupil, Mr. C. Neate, Assoc. Inst. C.E.; and also on the plan for the sewerage of the city of St. Sebastian. In 1854, he reported to the Prussian Government on a proposed naval establishment at Heppens, on the river Jade. In 1854-5, he inspected the river Elbe, on the part of the Hamburg Senate, from Hamburg to Cuxhaven, and designed various improvements in it, with a harbour at the latter place. These works have recently obtained the sanction of the Hamburg Senate. He also devised a system of railways for the country between Madrid and Oviedo, as well as improvements of the river Ebro.

He was less engaged in railways than in hydraulic works, but, in England, he executed the Birkenhead, Lancashire, and Cheshire Junction Line, and, in India, he had the direction of the 'East Indian,' and the 'Madras Railways,' the former projected by Mr. (now Sir) Macdonald Stephenson, Assoc. Inst. C.E., as the first of the vast system now being formed, and which will work such a revolution in the destiny of the Indian Empire. The Ceylon and the Pernambuco lines were also under his charge.

He was likewise consulting Engineer for the Regent's Canal and Dock Company, the Lynn Harbour Commissioners, the Exchequer Loan Commissioners, and the Jarrow Dock Company on the river Tyne.

In the year 1856, a report by Mr. Rendel and Mr. Simpson, M. Inst. C.E., on the New Westminster Bridge, caused considerable excitement, and induced much public discussion, relative to that structure; and his designs for the suspension bridge across the ornamental water in St. James' Park, were only completed just before his fatal illness commenced.

About a month previous to his death, he was attacked with what appeared to be simply ague, or intermittent fever; but was, in reality, a fever consequent on internal disease produced by the depressed state of the whole system, due to an overwrought body and mind. For some time he partially rallied, but after much suffering, it became apparent, that his strength was exhausted, and

on Friday morning the 21st of November 1856, he calmly drew his last breath, in the fifty-seventh year of his age.

Mr. Rendel was a man of great energy, clear perception, and correct judgment. He was systematic in his habits, accurate in his observations, ever anxious to discharge his duties to the best of his ability,—generous in disposition, and possessing a warm appreciation for whatever was beautiful, or excellent, in Nature. With an admirable presence, he combined tact and statesmanlike qualities, which very greatly contributed to his success as a man of business. His practical knowledge was well directed, and he knew how to make good use of the scientific acquirements and skill of all whose services he engaged. His evidence before Committees of the Houses of Parliament, was clear and convincing,—seldom failing in carrying his point,—and his reports on engineering works are so well conceived and drawn up, that it may be hoped they will be collected and published for the benefit of the profession. He was very frequently called upon by the Government to report on large works, the most implicit confidence being reposed in his truthfulness, the correctness of his views, and the fearless expression of his opinions. With these qualities, which were fully appreciated, it need scarcely be mentioned, that he rose rapidly to a very high position in the world, as in his profession. He became a Fellow of the Royal Society, and was elected upon the Council; he was a very early Member of the Institution of Civil Engineers, having joined it in 1824, and had been for the last sixteen years upon the Council, holding the post of President during the years 1852 and 1853.

He was as amiable and kind in private life as he was energetic and firm in public, and his decease cast a gloom over the whole of the profession, of which he was a brilliant ornament.

MR. THOMAS HENRY STATHAM was born at Liverpool, about the year 1810. His father had been for many years Town-Clerk of that extensive borough, and when he resigned that situation, in consequence of the passing of the Bill for the Reform of Municipal Corporations, his retirement was greatly regretted, and created much discussion among the politicians of that town. Young Statham was articled to the late Mr. F. Giles, and during his pupilage, he was intrusted with some extensive marine and other surveys, as well as with the superintendence of the execution of some Dock and Canal works. His first intention was to practise on his own account, and he commenced business in Liverpool, but he was induced to relinquish this, in 1834, when he received the appointment of Resident Engineer on the district