leave the neighbourhood. This, however, he could not be prevailed upon to do, and on the 11th of January, 1874, he succumbed to a stroke of apoplexy.

The flourishing state of the Kent Waterworks, as compared with its position when he assumed the management, is the best proof of his ability. He was elected a Member of the Institution of Civil Engineers on the 1st of May, 1856, and was a Fellow of some other Societies.

SIR JOHN RENNIE, the second son of the late Mr. John Rennie, was born at 27 Stamford Street, Blackfriars Road, on the 30th of August, 1794. After receiving the rudiments of education at home he was sent first to Dr. Greenlaw's school at Isleworth, and subsequently to the celebrated Dr. Charles Burney, at Greenwich. On leaving the latter, in 1809, his father determined to train him for the engineering profession under his own eye. Sir John, accordingly, entered his father's manufactory at Holland Street, Blackfriars, and was there initiated into the minutest details of the profession, even to sawing planks, planing, and turning. From thence he passed to the drawing office, and was afterwards taught practical surveying by the late Mr. Francis Giles.

In 1813, having obtained a tolerable knowledge of his profession, Sir John was placed under Mr. Hollingsworth, the resident engineer of Waterloo Bridge, the foundations of which he personally superintended through the severe winter of 1813–14. In 1815 the elder Rennie was appointed Engineer to the new Southwark Bridge Company; and, although nominating Mr. Meston resident engineer, he in reality confided the details to his son. On this occasion, Sir John, although a mere boy, was the first to introduce large blocks of Scotch granite from Portishead. With the exception of a short time employed with Mr. Giles in surveying the coasts of Scotland and Ireland, for the purpose of establishing a line of mail packets for the Government, between Portpatrick and Donaghadee, the superintendence of Waterloo, and particularly Southwark bridges, occupied Sir John until the opening of the latter, in 1819; after which Mr. Rennie, always anxious to promote his son's professional education in the widest and most liberal manner, sent him abroad, to afford him the opportunity of studying the works of ancient and modern engineers. How well young Rennie profited by the opportunities thus afforded him is attested by the note-books he has left, replete with drawings and descrip-

tions of various works, as well as by the knowledge he acquired of hydraulics, and his familiarity with the architectural and engineering works of the ancients.

On the death of the elder Rennie, the business was divided between his two elder sons, who remained in partnership as regards the works in Holland Street, but the principal part of the mechanical business fell to the late Mr. G. Rennie, M. Inst. C.E., while the completion of the engineering works devolved principally upon Sir John. The most important of these works was new London Bridge. The old bridge, which narrowed at once the traffic above and below its site, had long been condemned, and numerous plans had been formed at different times for its reconstruction, together with quays for the river banks. After long discussion, a design of the late Mr. Rennie was, in substance, approved of; and, on his death, Sir John was commissioned to carry it into execution. The original plan was almost entirely adhered to; but the determination of the Corporation to preserve the old bridge and its approaches, as a temporary means of communication, led to the construction of the present bridge slightly higher up the river, together with new approaches on either side. The disputes as to the bridge were numerous and violent, until the construction of what was simply a great convenience for the metropolis assumed almost the importance of a national struggle; and when a bill was required to give enlarged powers to the Corporation, consequent on the necessity for fresh approaches, five Cabinet ministers (the Duke of Wellington, the Premier, being in the chair) sat on the select committee of the Lords, and the session of Parliament was prolonged, in order to pass the bill. The new bridge was opened by his late Majesty William IV., in 1831, and Sir John received the honour of knighthood,—being the first of his profession since Sir Hugh Myddleton, similarly distinguished.

London Bridge was, however, but a part of the inheritance which Sir John had received. The completion of Sheerness Dockyard, of Ramsgate Harbour, and of Plymouth Breakwater also devolved upon him, in the capacity of Engineer to the Admiralty, a post in which he succeeded his father.

As regards Ramsgate, originally designed and commenced by Smeaton, and continued by the elder Rennie, Sir John completed the two outer piers, besides rebuilding the greater portion of the original structure. Over the breakwater at Plymouth he exercised a general superintendence, confiding the details and personal supervision to Mr. Whidbey; but he provided the berm on the seaward face, where additional strength was required against the

action of the sea. At Woolwich he executed a large dock, mast, and pond, now, with the rest of the dockyard, disused; also some minor works at Chatham. One of his leading works was the Victualling Establishment at Plymouth, of which the machinery was mainly designed by his brother.

At this time, and for many years afterwards, he was engaged on alterations and additions to Kingstown, Portpatrick, Portrush, Donaghadee, Warkworth, Sunderland, Hartlepool, Cardiff, and Whitehaven harbours, together with the enlargement of the Newry canal, several designs and reports for the harbours of the Isle of Man, the bridges at Staines, New Galloway, and over the Serpentine, the latter designed by the late Mr. Rennie.

In the drainage and reclamation of land, Sir John followed in the footsteps of his father, although he had not actually to carry out any specific designs. Among the works of this class may be mentioned the completion, in 1822, of the Eau Brink cut, near King's Lynn, by which a lowering of water of 7 feet was gained in the Ouse; the construction, in conjunction with the late Mr. Telford, of the Nene outfall below Wisbeach, which had the effect of similarly depressing the water-level by from 10 feet 6 inches to 11 feet, and which would have been still greater, had not strong opposition prevented the improvements being carried to the higher grounds at Peterborough, as was originally intended. These works were begun in 1826, and finished in 1831. Subsequently Sir John reported, for the Duke of Bedford, on the drainage of Whittlesea Mere and the surrounding fens, an area of 50,000 acres; but his plan, owing to the opposition of conflicting interests, was never carried into effect. In 1827–8 he restored the harbour of Boston, which, owing to neglect and bad management, had been nearly ruined, by forming a new channel, 1 mile in length, for a portion of the course of the Witham below the town. At an expense not exceeding £33,000, the navigation was so improved, that the town was accessible to vessels drawing 15 feet to 16 feet at spring tides, and from 12 feet to 13 feet at neaps. Besides the above, Sir John executed various improvements on the Welland; the effect of the whole being to improve the drainage of nearly 800,000 acres, and to reclaim 6,000 additional acres previously useless.

As may be imagined, Sir John, constantly employed on these works, so congenial to his tastes, could not fail to form some comprehensive plan for the entire district. Accordingly, when a committee of the leading landowners requested him to survey and report upon all the rivers falling into the Wash, he devoted a year to a thorough examination, not only of the rivers, but of

the Wash itself, and elaborated a scheme by which the navigation of the Nene, Ouse, Welland, and Witham would have been improved, the water lowered, and from 150,000 to 200,000 acres of land reclaimed from the sea. But this scheme appeared too great for realisation, and it was subsequently considerably reduced, and divided into two, of which the Norfolk Estuary Company proposed to reclaim about 40,000 acres, and the Lincolnshire Company a somewhat less amount. Eventually the opposition of the Lincolnshire landholders, who feared for their foreshore rights, led to the latter scheme being abandoned; while the Norfolk Estuary Company was so hampered by conditions and obligations, that, though still in existence, it has as yet inclosed but a very small portion of land. One benefit, however, was derived from their operations. The plan included a new channel for the mouth of the Ouse; this, the first work undertaken, besides greatly improving the port of Lynn, has been instrumental, in conjunction with the Eau Brink cut, in lowering the water in the Ouse to 11 feet below its former level. In spite of this failure, and two others somewhat similar in Holland and on the Essex coast, Sir John always upheld the feasibility and great value of these reclamations. He maintained that at least 600,000 acres in England and Scotland would amply repay the trouble and expense of inclosure, besides adding greatly to the permanent wealth of the country, and he has left in manuscript numerous suggestions as to the mode in which these may be effected.

In 1825–6 Sir John, in partnership with his brother, made his first contribution to railways by designing the Manchester and Liverpool line. Ultimately, however, the direction was conferred upon Mr. G. Stephenson. For this line the Messrs. Rennie, after a very careful investigation, decided that the gauge should be 5 feet 6 inches, a medium between the present broad and narrow gauges; but when the control of the works was conferred upon Mr. Stephenson, he adopted the old colliery gauge of 4 feet 8½ inches, which, as the narrow gauge, has since become universal.

From that time until the great extension of the railway system in 1844–5, Sir John Rennie had but little to do with this branch of the profession, confining himself principally to hydraulics; and, though he prepared several bills, the lines were not carried out, but several have since been constructed on similar plans to those he proposed. It may here be mentioned that his principle in laying down a line was to make it as direct as possible, tapping the districts which lay on either side of the main line by nearly straight branches.

In 1852 he laid out a system of railways for Sweden, for which he received the Order of Gustavus Wasa; and three years afterwards, in 1855, he designed a series of railways and five harbours for Portugal, including a harbour of refuge for Oporto; none of which, however, were carried out, though he was subsequently commissioned to erect a breakwater at Ponte Delgada, at the isle of St. Michaels, one of the Azores, and the chief seat of the orange trade. For these services he received the Portuguese Order of the Tower and Sword. In 1861 he was invited by the Corporation of the City of London to submit competitive plans for the rebuilding of Blackfriars Bridge. In the succeeding year he reported to the Municipality of Vienna on supplying the city with water, and in 1862 he was Chairman of the Civil Engineering section of the International Exhibition. This was almost the last of his public acts; he shortly afterwards retired from the Norfolk Estuary works, and Ramsgate Harbour being acquired by the Government, he ceased to be the inspecting engineer. From this time he seldom appeared in public save at the Royal Society Club, of which he was remarkably fond. He occupied his leisure with the composition of several works, especially on hydraulics, which remain in manuscript.

The mechanical achievements, of which Sir John Rennie could claim a share, were mostly carried out in connection with his brother, the late Mr. George Rennie, M. Inst. C.E., to whose memoir reference may be made.[1]

Sir John Rennie might, in his declining years, have claimed the title of "Dean of the Faculty of Engineers." He stood alone, the last of a bygone race, a link connecting the Brindleys, the Smeatons, the Rennies, and the Telfords of the old system with the Stephensons and the Brunels of the new. His presidential address to the Institution in 1846 was a complete history of the rise and progress of the profession;[2] while the monograph on Plymouth Breakwater and, still more, his work on British and Foreign Harbours, for which he received tokens of honour from the sovereigns both of Russia and Austria, are no insignificant memorials of literary skill. He contributed the following Papers to the Institution:—"An Account of the Drainage of the Level of Ancholme, Lincolnshire;"[3] "On the Ancient Harbour of Ostia;"[4] and "On the improvement of the Navigation of the River Newry."[5]

[1] *Vide* Minutes of Proceedings Inst. C.E., vol. xxviii., p. 610.
[2] *Ibid.*, vol. v., p. 19.
[3] *Ibid.*, vol. iv., p. 186.
[4] *Ibid.*, vol. iv., p. 307.
[5] *Ibid.*, vol. x., p. 277.

In his retirement he addressed several letters to "The Times" on the drainage and improvement of land, and the storage of water and regulation of rivers. A letter on the management of the rivers and marshes of Italy having attracted the notice of Signor Sella, then premier, procured for him the Order of St. Maurice and Lazare.

It only remains to add that Sir John's acquirements extended much beyond his profession. Understanding several languages, he was extensively versed in general literature. He was long a Member of the Royal Society, and other scientific bodies; and was one of the first persons to whom Sir Humphry Davy applied when forming the Zoological Society.

Of his personal character one trait may be sufficient. Throughout his lengthened career, and in spite of the numerous disputes in which he was involved, he never bore a moment's envy or malice against any human being. His posthumous memoirs are full of the kindest notices of all with whom he came in contact; and whenever he had occasion to notice the Stephensons and their works, it is with a eulogy which their most devoted adherents might rival but could not surpass.

Sir John Rennie was elected a Member of the Institution on the 25th of June, 1844; he became President on the 21st of January, 1845, retaining the office for three years. He died at Bengeo, near Hertford, on the 3rd of September, 1874, just after completing his eightieth year.

MR. JAMES RAINE RUSHTON was the second son of the late Edward Rushton, stipendiary magistrate of Liverpool. Having shown a strong natural aptitude for mechanics, he was, under the advice of the late Mr. James Walker, Past-President Inst. C.E., removed at an early age from the London University School, and placed as an apprentice with Messrs. Fawcett, Preston, and Co., mechanical engineers of Liverpool, with whom he remained for five years. He then entered the locomotive shops of the Liverpool and Manchester Railway Company, and obtained a thorough knowledge of locomotive work. Next he was for three years in the office of Mr. Edward Woods, M. Inst. C.E., who was then in charge of the old Liverpool and Manchester railway. On the amalgamation of the above line with the Grand Junction and London and Birmingham lines, Mr. Woods was appointed Engineer for the construction of new works on the northern division of the amalgamated lines; and Mr. Rushton