

the dredging of the harbour and for additions to the custom-house, as well as of eventually constructing a breakwater and enclosing the harbour in accordance with a plan which had been submitted to the Government by the late Mr. La Trobe Bateman, Past-President Inst. C.E. The dredgers and barges were sent out in pieces and had to be put together in a place where few facilities existed for such work. The foundations of the sea-wall of the custom-house, exposed to very rough weather, were formed of a solid continuous block of concrete in 20 feet of water where no hold was to be had for piles to form a coffer dam, the bottom being of solid gneiss-rock. Owing to political changes the latter part of the programme was not carried out; financial embarrassment arose and Mr. Elliot had no alternative but to send in his resignation.

He again returned to England in 1875 and for the next few years was engaged in examining and reporting on various projects. In 1879 he represented Messrs. Wilson, Sons and Co. on the construction of the Great Western of Brazil Railway in the province of Pernambuco and had charge from the commencement to the completion of the line in 1883. He then went to Buenos Ayres and for the next six years carried out for Messrs. Devoto, the contractors, the construction of the Buenos Ayres drainage works. In January, 1891, he was appointed by Messrs. De Morgan, Snell, and Co. Manager and Engineer of a large cotton-mill at Pernambuco. After selecting a site and completing the necessary negotiations Mr. Elliot was making rapid progress with the erection of this mill, when he was attacked by yellow-fever, from which he died on the 19th of June, 1892.

Mr. Elliot was a man of high principle, strict integrity and firmness of character. He enjoyed the confidence and esteem of his employers and of those who worked under him, and held the highest testimonials from many of the leading South American Engineers. He was elected an Associate of the Institution on the 1st of December, 1863, was placed in the class of Associate Member on its creation in December, 1878, and was transferred to the class of Member on the 28th of March, 1882.

JOHN GEORGE GAMBLE, eldest son of Dr. Harpur Gamble, R.N., was born on the 22nd of January, 1842. After private tuition, he went in 1854 to the Royal Naval School, New Cross, where he remained until 1859, when he obtained a Mathematical

Demyship at Magdalen College, Oxford. He took a First Class in Moderations in 1861 and gained the Junior Mathematical University Scholarship in the following year. He was placed in the Second Class in the Final School of Literæ Humaniores in 1863 and in the First Class in the Mathematical School in 1864. Some years later he obtained the Gold Medal for the Johnson Memorial Prize Essay, the subject being the "Laws of Wind." Mr. Gamble remained at Oxford after taking his degree and, amongst other work, for some time took the Mathematical Lectures at Lincoln College.

In 1866 he became a pupil of Mr. (afterwards Sir) John Hawkshaw and was soon sent to the works of the New Albert Dock at Hull, of which Mr. J. C. Hawkshaw was the Resident Engineer. Mr. Gamble at the end of 1870 was appointed by Mr. Hawkshaw Resident Engineer of the new intercepting and outfall sewers at Brighton, an account of which he presented to the Institution.¹ The tunnelling work followed a sinuous course so as to keep beneath the high road, and in setting it out he adopted with ordinary instruments very perfect arrangements, which depended for their success on well thought-out and systematical methods of eliminating errors by taking true averages of many observations.

Mr. Gamble was an active secretary of Section G of the British Association at Brighton in 1872.

In 1874 Sir John Hawkshaw was requested by the Government of Brazil to advise as to several of the important harbours in that country, and Mr. Gamble, with the late Mr. James Graham, an experienced surveyor, went, with two assistants, Mr. Murray and Mr. Hamilton Dobson, to collect the information Sir John Hawkshaw required. The harbours specially to be reported on were Maranhão, Ceará,² Recife or Pernambuco, the mouth of the Parahyba River leading to Campos, and Rio Grande do Sul. The staff left England in July, 1874, and went first to Pernambuco. Mr. Graham and the two assistants devoted themselves especially to the land surveys while Mr. Gamble undertook the soundings, borings and the collection of information as to tides and currents and as to the materials to be found. At Ceará Mr. Murray was taken ill of yellow fever and died. Mr. Graham was overcome by the heat and had to return, first to Pernambuco and then to Europe; and while Mr. Gamble and Mr. Hamilton Dobson were on the voyage to Pernambuco Mr. Dobson was taken

¹ Minutes of Proceedings Inst. C.E., vol. xliii, p. 191.

² *Post*, p. 390.

ill and died. Mr. Gamble was thus left alone to complete the work at the two important southern rivers. He was fortunate in obtaining an assistant in Mr. Edward Compton, who had just finished work at Maranhãõ. Mr. Compton speaks in terms of great praise of the energy of Mr. Gamble in carrying out the soundings and other work under circumstances of difficulty and danger, especially at the mouth of the Parahyba do Sul River and when landing at Torres (on the coast between Rio Grande do Sul and Santa Catharina) to examine the stone obtainable in the neighbourhood. Mr. Gamble returned to England in April, 1875, and was engaged for some little time in bringing together the results of his work. Sir John Hawkshaw's report was made in July.

Immediately after this Mr. Gamble was appointed Hydraulic Engineer to the Government of Cape Colony, where he arrived in October, 1875, studying the Dutch language on the voyage. He at once made an extended tour through the northern districts, embodying the information obtained in a series of valuable reports on which useful legal enactments have since been based. At Port Elizabeth, which he next visited, the Municipality carried out works in accordance with his recommendations, the result being that Port Elizabeth possesses the finest waterworks in South Africa. These formed the subject of a Paper read before the Institution in 1883.¹ Under an Act of 1877, consequent on Mr. Gamble's report, a fair amount of progress in irrigation was made. The chief Government works executed under his supervision were a storage-reservoir at Brand Vley, Annshaw Irrigation Channel, and the Stolshoek and Van Wyk's Vley reservoirs; the last in a most exceptional site for securing economy in the construction of the impounding dam and works. Among the various town water-supplies, in addition to that of Port Elizabeth already referred to, carried out under Mr. Gamble's supervision, were those of King William's Town, East London, Queenstown, Somerset East, Riversdale and Graaff Reinet. These and other works in the Colony were described in a Paper² presented to the Institution in 1887.

Mr. Gamble induced the Government to establish rain-gauges at every magistracy, thus raising the number of trustworthy recording stations to 250; he produced the first good rainfall maps and procured the publication of daily weather-bulletins, undertaking in his office all the work of collating the reports.

¹ Minutes of Proceedings Inst. C.E., vol. lxxiv. p. 128.

² *Ibid.*, vol. xc. p. 255.

He also took a keen interest in everything relating to scientific and educational matters in the Colony, as in the Philosophical Society, the Public Library, and especially as Examiner and Member of Council of the Cape University. The Parliamentary Papers of the Colony indicate his industry within and without his department. A careful list of all recorded heights in the Colony and a catalogue of the books and papers in all languages relating to climate in South Africa, are examples of his industry in matters outside his duties. In 1878 Mr. Gamble married Miss Constance Brounger, daughter of Mr. W. G. Brounger, Engineer-in-Chief for the Cape Government Railways, and had three daughters. On the abolition of his office in 1886 he returned to England.

Consequent on the Report of a Royal Commission, consisting of the late Sir James Allport, Mr. Abernethy, Mr. J. Wolfe Barry and Mr. J. T. Pim, on Public Works in Ireland, the Government determined in July, 1887, to appoint a "Chief Hydraulic Engineer." Mr. Gamble received the post and at once took up his duties, which consisted in the first place in preparing plans for application to Parliament in regard to the Rivers Barrow, Bann and Shannon. The scheme for the River Barrow required much investigation in working out the details of the system determined on for embanking the higher reaches of the river and dealing by back drains with the low-level ground behind the banks. In the Session of 1888 the three schemes had to be abandoned without coming before a Committee, owing to opposition in the House of Commons; they were again introduced in the Session of 1889, when the project for the River Bann passed the Committee, but for want of time had to be withdrawn.

For the Barrow, a district the condition of which the Royal Commission described as "deplorable," Mr. Gamble, after careful surveys and most painstaking investigation and calculations, matured a scheme in which the combination of moderate excavation in the river-bed with small embankments set back from the edge of the channel was shown to be the most economical method of protecting the land from floods. Any difficulties from the back drains were such as could be met without inconvenience. The estimate was £360,000. As soon as the project had been got ready for application to Parliament, full surveys and designs for the works were proceeded with during the year 1888 and were completed in 1889.

The drainage of the River Shannon was a subject which had been very much studied, and portions of the recommendations made by Mr. Bateman in 1867 had been carried out. The Royal

Commission recommended the prosecution of Mr. Bateman's works. The Government proposed to leave the construction in the hands of the Board of Works, but Mr. Gamble, in his capacity of Chief Hydraulic Engineer, advised with regard to the designs to be submitted to Parliament. The Bills of 1888 and 1889 for the Shannon works were not proceeded with, but some important recommendations of the Royal Commission have since been carried out. Mr. Gamble, in evidence before the Shannon Fisheries Inquiry, 1889, explained fully his views as to the works which should be undertaken throughout this river.

Notwithstanding these delays, inseparable perhaps from undertakings requiring Parliamentary sanction, the post thus occupied by Mr. Gamble seemed to promise a long career of usefulness in the public service. Unhappily these hopes were destined to be summarily disappointed. In the autumn of 1889 he was attacked by typhoid fever, which, after an illness of forty-eight days, proved fatal on the 7th of November, although, almost to the last, a favourable issue had been looked for.

Combining in a rare degree of excellence great mental gifts, diligently trained in the pursuit of truth, with a singular sweetness and modesty of character, Mr. Gamble, at every stage of his career, secured the esteem of those with whom he worked. His death called forth many sincere expressions of sorrow when it became known in South Africa; at home, a memorial from his Irish staff took the appropriate form of a contribution to the capital of the Benevolent Fund of the Institution.

Mr. Gamble was elected an Associate of the Institution on the 7th of December, 1869, and was transferred to the class of Member on the 28th of November, 1876. For the Papers above referred to he was awarded a Telford Medal and three Telford Premiums.

The following is a list, chronologically arranged, of the various Reports and Papers by Mr. Gamble:—

"The Brighton Intercepting and Outfall Sewers."—Report of the British Association for the Advancement of Science, Brighton, 1872, p. 245.

"Report on the Water Supply of Cape Town."—Cape Town, 1875.

"The Brighton Intercepting and Outfall Sewers."—Minutes of Proceedings Inst. C.E., vol. xliii. p. 191.

"Reports of the Hydraulic Engineer" (1876–85).—Parliamentary Papers, Cape of Good Hope.

"Report on the Water Supply of Port Elizabeth."—Port Elizabeth, 1877.

"Rainfall of South Africa," 26th June, 1878.—Transactions South African Philosophical Society, vol. i. p. 13.

"A Storage-reservoir in the Achteveld," 29th October, 1879.—Transactions South African Philosophical Society, vol. i. p. 219.

"Some of the Problems awaiting Scientific Research in South Africa."—Transactions South African Philosophical Society, vol. ii. p. 91.

"Summer and Winter Temperature in South Africa," 30th March, 1881.—Transactions South African Philosophical Society, vol. ii. p. 104.

"Rainfall in South Africa."—Quarterly Journal of the Meteorological Society, vol. vii. 1881, p. 3.

"Note on a Comparison of Maximum and Minimum Temperature and Rainfall on Table Mountain and at the Royal Observatory, Cape Town, during January and February, 1881."—Quarterly Journal of the Meteorological Society, vol. vii. p. 249.

"Proposals of the Table Mountain Water Supply Company," 26th April, 1882.—Transactions South African Philosophical Society, vol. iii. p. 5.

"The Barometer and the Winds," Annual Address as President of the South African Philosophical Society, 26th July, 1882.—Transactions South African Philosophical Society, vol. iii. p. xix.

"The Waterworks of Port Elizabeth, South Africa."—Minutes of Proceedings Inst. C.E., vol. lxxiv. p. 128.

Annual Address as President of the South African Philosophical Society, 25th July, 1883.—Transactions South African Philosophical Society, vol. iii. p. xlvii.

"Meteorological Notes," 4th December, 1884.—Transactions South African Philosophical Society, vol. iv. p. 10.

"Catalogue of Printed Books and Papers relating to South Africa.—Part II., Climate and Meteorology."—Cape Town, 1885.

"Altitudes above Sea-level of Places in South Africa South of 20° S. Latitude."—Cape Town, 1886.

"Water Supply in the Cape Colony."—Minutes of Proceedings Inst. C.E., vol. xc. p. 255.

"Rainfall on and around Table Mountain, Cape Town, Cape Colony."—Quarterly Journal of the Royal Meteorological Society, vol. xiv. 1888, p. 12.

The whole of these documents may be found in the Library of the Institution.

JOSEPH HINDLE, third son of the late Rev. Joseph Hindle, B.D., Vicar of Higham near Rochester, was born at Gravesend on the 5th of April, 1838, and was educated first at a preparatory school at Ramsgate and then at Oakham Grammar School under the Rev. W. S. Wood, D.D., the present vicar of Higham. In March, 1856, he was articled for three years to Messrs. George Rennie and Sons and in June, 1859, became a pupil of Mr. W. M. Brydone, then Chief Engineer of the Great Northern Railway, by whom he was subsequently employed on the Garston and Liverpool Railway.