

of Lieutenant. On demobilization he became Electrical Engineer to the South-Eastern & Chatham Railway and prepared a scheme for electrification of their south-eastern suburban lines (1918–23).

In 1923 he joined the Southern Railway as Electrical Engineer, New Works, and in this capacity prepared and implemented all schemes for electrification of the Southern lines. He was appointed Chief Electrical Engineer in 1938 and so remained until his retirement in 1946. He then became Consulting Engineer to the English Electric Company at their head office in Kingsway.

Throughout his railway career Alfred Raworth had to fight prejudice against the high cost of electric railways. This led him to practise rigorous economy in staff and engineering costs and to give meticulous attention to economical planning. Single-handed, he reached his own decisions, but had the complete confidence of Sir Herbert Walker, the Southern Railway's first General Manager. Under his guidance, the Southern advanced rapidly in electrification technology, so paving the way for the complete electrification system which Raworth recommended in a report produced shortly before his retirement, but did not live to see fulfilled.

The austerity of his methods did not reflect the man himself, who liked to relax among friends and played a good game of golf. Unfortunately he left no published work for the benefit of his successors.

He was elected direct to membership in 1942.

He is survived by his widow and a daughter.

Robert Valentine Burns, PhD, BSc

who was born on 4 November, 1898, died on 26 January, 1967.

Irish by birth, he went to school in Dundalk before emigrating to Canada at the age of 14. Here he continued his education at the Technical School in Toronto and at Jarvis Collegiate Institute. From 1919–23 he studied engineering at Massachusetts Institute of Technology, and took his BSc degree. In 1923 he also passed the Associate Membership examination. Ten years later he was to study at the City & Guilds London Institute, and in 1935 he received his PhD.

Harbour construction, dams and irrigation projects were his subjects, and in the course of his career he travelled widely—to the United States, Ceylon, Turkey, Haiti, and finally Thailand.

After working in the United States on several irrigation and dam projects, he went to Ceylon to take up an appointment with the government as a Research Engineer. In 1937 he completed the design and construction of an hydraulic research laboratory in Colombo and was appointed Divisional Irrigation Engineer, under the Director of Irrigation. He instituted a number of flood protection schemes (on the Nilwala, Kelani, Gin and Kalu rivers), and several drainage projects, before proceeding to Turkey: thence in 1951 to Haiti, where for the next seven years he was engaged on the Artibonite project (irrigation and drainage works). He then left for his final stint in Thailand.

After an eventful career, he retired to Florida in 1965.

He was a member of the American Society of Civil Engineers, and co-author with C. M. White of a paper, 'The protection of dams, weirs and sluices against scour'. *J. Instn civ. Engrs*, 1938, 10 (Dec.) 23. Corrigenda: 1938, 10 (Dec.)

133. Correspondence: 1939, 12 (Oct.) 251. This paper was awarded the Telford Premium.

Elected an Associate Member in 1937, he became a Member in 1946.

He is survived by his widow, three brothers and two sisters.

Grainger Hope Hargreaves, MC, BSc

who was born in Canton on 24 September, 1891, died on 7 February, 1967.

Educated at Victoria Park School, Manchester, and Oxford High School, he studied engineering at Manchester University and received his BSc in 1913.

His practical training was with Mr W. H. White (M), City Engineer, Oxford (1913-14), with whom he continued as Assistant for a further year, on water supply and sewerage.

During World War I he served from 1915-17 with a commission in the Royal Engineers on the Suez Canal defences. For the next two years, after acting as Staff Officer to the Chief Engineer, IVth Army, B.E.F., he became Liaison Officer to the American Expeditionary Force, and finally Staff Director (engineering stores) at GHQ, B.E.F. For his services he was awarded the Croix de Guerre (Belge) and the MC. He was demobilized with the rank of Major.

After the war he went to the Federated Malay States as Engineer to the Public Works Department, where with a labour force of 1000 men he was engaged on bridges and roads at hill stations—their location, design and construction. A further year was spent as Acting Executive Engineer at Alor Star, Kedah, before he returned to England, where for six months he worked as Divisional Surveyor to Norfolk County Council.

Mr Hargreaves became Assistant Engineer to the Ministry of Transport (Bridges) in 1926, working on design and examination of designs for bridges, investigation of failures and remedial measures. Promoted Inspector to the Ministry in the metropolitan area in 1935 on improvement and traffic schemes and as Engineer to the Traffic Advisory Committee, he was later transferred to an area covering Kent, Surrey and Sussex, in charge of all Ministry road engineering work, highway maintenance and the preparation of plans and contract documents for 12 miles of by-pass roads at Maidstone, Swanley and Sellindge (the London-Folkestone-Dover Road).

In the period 1935-45 he was in charge of the construction of two airfields by direct labour, supervised construction of six other airfields, and in two further cases the extension of runways. During World War II he was responsible for works carried out with a labour force of 500 men for the military authorities.

Appointed in 1945 Divisional Road Engineer (Wales and Monmouth Division), he was transferred in the same capacity to the Metropolitan Division two years later. In 1949 he became Assistant Chief Engineer at Ministry headquarters, where in 1954 he was made Deputy Chief Engineer. On resigning from this post and from the Ministry in 1958 he set up on his own account as a consulting engineer, also acting in association with a firm of consultants.

He was elected an Associate Member in 1917 and became a Member in 1945.

He is survived by his widow.