on general traffic problems. He was an Associate of the City & Guilds Institute, a Fellow of the Institution of Structural Engineers, a member of the Institute of Transport and an honorary member of the Institution of Highway Engineers. His book, 'Concrete Roads', appeared in 1934, and he was co-author of other publications.

Major Smith's death after a long illness is felt as a painful loss to a wide circle of friends. He was on the Institution's Roll for 62 years. Enrolling as a Student in 1907, he was elected to corporate membership in 1913.

He is survived by a son and three daughters.

Joseph Reuben Harry Otter, BSc(Eng)

who was born on 1 December, 1904, died on 26 December, 1969.

Educated at Westminster City School, he studied engineering at the City & Guilds College, taking his BSc(Eng) degree with first class Honours in 1926. Then followed three years' practical training with Rendel, Palmer and Tritton, consulting and designing civil engineers, under H. J. Fereday. To this firm Otter was to devote the major part of a distinguished career, covering almost all aspects of civil engineering. He was one of the first to apply computer techniques to engineering problems.

In 1929 he became an Assistant Engineer in the firm, engaged on the design of the Irrawaddy Bridge for Burma Railways. A year later he started work on the design of two new Thames bridges and the improvement of a third, but owing to the 'thirties' slump, none of these projects got off the ground at that time. The new Chelsea Bridge, for which he prepared detailed designs, was temporarily abandoned: the proposed suspension bridge scheme for Charing Cross was not carried out. Tenders were invited for reconditioning Waterloo Bridge by underpinning, but nothing further happened. Otter then worked on the reconditioning of Nam-Kha Suspension Bridge for the Public Works Department, Burma: this was followed by design work on the Paung Chaung Aqueduct, under J. M. B. Stuart. He was next engaged on design studies for the new Howrah Bridge, Calcutta. Several alternative designs, including a suspension bridge, were considered in some detail to decide on how best to comply with the Port Commissioners' requirement for a clear 1900-ft waterway.

At this time his firm was engaged by the LCC on the demolition of Waterloo Bridge and the building of the new Chelsea Suspension Bridge, for which earlier plans had been shelved. On the first project, Otter designed jacking gear and supervised jacking operations on site, with H. Nolans. He then prepared the designs and supervised all the working drawings for Chelsea, the first self-anchored suspension bridge in Great Britain.

Next to India in 1937, where he worked on the new Howrah Bridge on the staff of the Resident Engineer, A. Webster, in charge of the erection on site of the steel superstructure (total estimated cost, £1 600 000). This continued until, in 1943, he took temporary leave of Rendel, Palmer and Tritton to become Principal Civil Engineer to Merz and McLellan (India) on the construction of foundations and cooling works for five major power stations. In 1951 he became Chief Engineer and Manager of Merz, Rendel, Vatten (Pakistan), at that time consulting engineers for the new Naval dockyard and dry dock at Karachi. Rejoining Rendel, Palmer and Tritton in 1955, he became a partner of the firm a year later, responsible for colliery works, several major road and bridge projects* and a wide variety of computer investigations.

Joseph Otter was one of the first to grasp the implications of applying computer techniques to the solution of engineering problems. His paper on 'Tidal Flow Computations', written in conjunction with A. S. Day,† was a source paper for other workers in this field and was followed by his enthusiastic development of the dynamic relaxation method of analysis with his co-author. The technique was successfully applied to a variety of problems, including those presented by prestressed concrete pressure vessels for nuclear power stations and other complex stress situations.

He combined to a remarkable degree professional distinction with a wide range of original work in engineering science and could concentrate to the exclusion of all else on the subject in hand. It is perhaps significant that in 1966 he was the first civil engineer to be created a Visiting Professor at Imperial College.

In the period 1965–66 he became aware that a number of universities had produced different solutions for the same arbitrarily simple 'Type 1' arch dam, in connexion with the Arch Dam Committee of the Institution. Characteristically he decided it would be interesting to try dynamic relaxation, and in the space of three weeks, in his spare time, produced an answer since accepted as definitive. At Imperial College he stimulated much of the work that followed on doubly curved arch dams, orthotropic plates, etc., and initiated work at other universities, often by the gift of a programme with full instructions.

Otter had a brilliant brain and a phenomenal capacity for work. During World War II he taught himself Japanese and Morse at odd moments and helped the war effort in India by decoding secret enemy messages. Such qualities, combined with a natural warmth and sincerity and the gift of enthusiasm, added to his remarkable stature both as an engineer and lecturer.

He served as Adviser to the Royal Commission which investigated the collapse of the Second Narrows Bridge, Vancouver, while under construction in 1958, and represented the Association of Consulting Engineers on the British National Committee of the Permanent International Association of Road Congresses from 1961 onwards. He was a member of the Organizing Committee of the Conference on Stresses in Service held at the Institution in March 1966: when invited to help on the Professional Interview he was always ready

*Including the Heads of the Valley Road in South Wales. He was also a leading member of the Channel Study Group and contributed to studies for the Thames Barrier.
† See *The Engineer*, Jan. 1960, p. 177.

to co-operate. Just before his death he was co-opted on to the Institution's Sub-Committee on Continuing Engineering Studies. Two papers of which he was part-author were presented to the Institution, the first of which was awarded the Telford Premium in 1968 (see under).

An Associate of the City and Guilds Institute, he was awarded a diploma by Imperial College, and was a Professional Associate of the Royal Institution of Chartered Surveyors.

Joseph Otter was on the Roll for 37 years: elected to corporate membership in 1932, he was transferred to the senior grade in 1947.

He is survived by his widow, a daughter, and a son, who is training to be a civil engineer.

Papers:

Co-author with A. C. Cassell and R. E. Hobbs of 'Dynamic Relaxation', P. 35 (Dec. 1966), 633. Discussion: P. 37 (Aug. 1967), 723. *Awarded Telford Premium.*

Co-author with A. C. Cassell and R. E. Hobbs of 'Computer developments as a tool for civil engineering design and control'. Informal discussion: P. 37 (June 1967), 397.