

in the action of tides, waves and running water, and he devoted much time to the study of the principles to be observed in the improvement of tidal harbours and entrances. His views on this subject were set forth in various pamphlets, the most important being that on "The Conservation and Improvement of Tidal Rivers,"¹ published in 1853. He made several valuable reports to the Admiralty on harbours of refuge, his predictions as to the results of various works having nearly all been verified.

Although Captain Calver had retired from active service he continued to take great interest in all questions relating to the Navy, to harbours, and to the protection of ships on sea-shores. In 1876 he wrote a pamphlet entitled "The Cry for National Harbours, and its Connection with our Defective System of Public Harbour Legislation,"² which attracted much attention, as it was chiefly directed against the then proposed extension of Dover Harbour.

The latter years of Captain Calver's life were passed abroad and he died at Vevey in Switzerland on the 28th of October, 1892. He was elected an Associate of the Institution on the 10th of April, 1866, on the ground that, having made the physical laws in operation round our coasts the subject of special study, and having directed the experience thus gained into a practical channel by his writings, he was enabled to concur with Civil Engineers in the advancement of professional knowledge.

JOHN STINSON FARMER, born in 1827, entered at an early age the service of the London, Brighton and South Coast Railway Company; and in 1849 was appointed Assistant Traffic Manager of that line under the late Mr. George Hawkins.³ He held that post for thirteen years; and during the prolonged absence of Mr. Hawkins, through ill-health, was responsible for the management of the whole of the extensive traffic of the Brighton Company.

In 1862 Mr. Farmer entered into partnership with Mr. John Saxby, a colleague in the service of the London, Brighton and South Coast Railway Company, and with him founded the business for the manufacture of railway signals and safety-appliances which

¹ Library Inst. C.E.

² Library Inst. C.E. and *The Engineer*, vol. xlii. p. 251.

³ Minutes of Proceedings Inst. C.E., vol. xcv. p. 397.

has since become so well known and so important. Works were erected at Kilburn, adjoining the London and North-Western Railway, and soon became the centre of an extensive industry. Mr. Saxby's interlocking system provided a mechanical reciprocating communication and action upon all the points and signals of a railway junction, whereby not only those points and signals which were in direct relation to one another were made to work in harmony, but all the other signals of the system were at the same time controlled and locked against improper or dangerous use. The first apparatus, introduced at Bricklayers' Arms, consisted of eight semaphore signals; and there were six pairs of points concentrated within the signal-cabin, all so governed and locked that it was impossible to give any signal contrary to the position of the points or in conflict with other signals. This was described by Mr. Farmer in the course of an interesting discussion at the Institution in 1874 upon a Paper¹ on "The Fixed Signals of Railways," by Mr. R. C. Rapier. In previous methods the locking was effected by the movement of the lever and if the apparatus became slack, the man in charge might be able to lower the signal at a wrong time; but in 1867 the firm introduced a most important invention, by means of which the locking was effected by the movement of the spring catch and a wrong signal could not be given, either by negligence or by slackness of the apparatus.

In 1875 Messrs. Saxby and Farmer brought out a continuous mechanical brake which attracted some attention at that time. Each vehicle was supplied with the brake apparatus, which consisted of rods worked by means of a four-way crank, in one arm of which a long slot was cut out for the purpose of connection. In attaching the couplings, which were fixtures, the brakes could be applied at either end of the train, or from all parts at once or separately; so that no matter into how many parts a train might be divided, each part was under the control of the brake and each wheel could be skidded, all that was required to be done being to slip the end of the heavy weight. The result was continuity of brake-power; so that, should the train part in two when in motion, the portion no longer attached to the engine was brought automatically to a standstill.

Among the various safety-appliances which Mr. Farmer assisted in bringing out may be mentioned the united lock and block-working apparatus, the ground-locking apparatus and several

¹ Minutes of Proceedings Inst. C.E., vol. xxxviii. p. 142.

telegraphic block instruments; and there can be no doubt that the present rapid and safe travelling on railways is due in a great measure to the firm with which he was so intimately connected for upwards of thirty years. Mr. Farmer died suddenly, from heart disease, at Ifold, near Billingshurst, in Sussex, on the evening of the 12th of December, 1892.

He was elected an Associate of the Institution on the 1st of December, 1868.

MAJOR HENRY GEFFCKEN KUNHARDT, R.E., son of the late Mr. G. E. Kunhardt of Staten Island, New York, U.S.A., and Elizabeth, daughter of the late Mr. Stephen Moulton, J.P., of Bradford-on-Avon, was born at Staten Island on the 6th of November, 1850, and was educated at Dr. Schleiden's school at Hamburg and at the Somersetshire College, Bath. From the latter he proceeded in 1869 to Woolwich Academy, fourth out of one hundred and forty competitors, was placed first in the half-year's examination and on the 12th of July, 1871, passed out first, with 29,614 marks, taking a regulation sword for exemplary conduct, the Pollock Gold Medal for distinguished proficiency and prizes for military drawing and gymnastics. The Inspecting Officer remarked that it was "very pleasing to find that one of the cadets, Mr. Kunhardt, had carried off so many prizes, in addition to having gained the highest number of marks, an example which they would do well to emulate."

The usual term having been served at Chatham, Lieutenant Kunhardt left for India on the 1st of July, 1873, via New York and the United States, visiting China and Japan and arriving in Calcutta in November. On the 22nd of December he was gazetted to the Public Works Department as Assistant Engineer, 2nd-Grade, and was posted to the Punjab Irrigation Branch on the Delhi Division of the Western Jumna Canal. Having seen works of great importance at home and visited most of the largest engineering works in the United States, he was much disappointed at the prospect of his duties being confined to inspecting periodically a few hundred miles of canal distributaries. In January, 1874, therefore he obtained a transfer to the Punjab Northern State Railway, whence two months later he was again moved to Sir Richard Temple's Bengal Famine Relief Works which took the form of a railway in the province of