smelting pig iron on the left bank of the Bilbao River at San Nicholas. Mr. Stephens was appointed managing director of the company, and the erection of the Cantabrian Ironworks was briskly proceeded with, and was on the eve of completion when the Carlist war of 1874 put a stop to further operations. After peace had been established, the company were urged to proceed with the work; but confidence in the country had been undermined, and it was decided to sell the property for what it would fetch. Failing a purchaser in England, the Cantabrian works were sold to the Marqués de Mudela, for about one-third of the sum already spent on them, by whom they have been since carried on at a great profit. Mr. Stephens took in hand the completion of the works which were duly started in the year 1877. He remained as manager until about 1880, and subsequently undertook general consulting work, and other business up to the time of his decease. He died in Bilbao on the 6th of January, 1889, in his 60th year, and was buried in the English cemetery, by the side of his wife. Mr. Stephens was of a warm and genial disposition, and commanded the esteem of all with whom he had dealings. By a large circle of friends and acquaintances, both Spanish and English, his presence will long be missed. Mr. Stephens had a sound and comprehensive knowledge of mechanical engineering, and the manufacture of iron and steel, and the laying out of the Cantabrian Ironworks, and its lofty and well proportioned chimney of about 230 feet will always remain a worthy monument to his engineering skill. From the year 1881 to the time of his death, Mr. Stephens was Managing Director of the Bilbao and Santura Tramway, 9 miles in length, in the formation of which he took an active part.

Mr. Stephens was elected a Member of the Institution on the 4th of December, 1888.

THOMAS SUMMERS was born in London on the 5th of August, 1825. He was educated at private schools and at the London University School, and in 1841 was apprenticed to Mr. John Hague, a well-known mechanical engineer of that day, who had works on the Thames at Millwall. In 1843 young Summers was transferred to his cousin Mr. W. Altoft Summers, at whose works at Southampton he completed his time. At that period Mr. Altoft Summers was in partnership with Mr. C. A. Day under the name of Summers and Day, at the Northam Ironworks, and the subject of this memoir became successively chief draughtsman and

manager of this important undertaking, which at intervals employed more than two thousand men. Mr. Altoft Summers retired about the year 1858, and some years after Mr. Thomas Summers became a partner, the style of the firm being altered to Day, Summers and Company, and being destined to achieve a world-wide reputation. Mr. Thomas Summers had previously become well known in engineering circles by his contributions to the professional magazines, and had been invited by the Turkish and some other foreign governments to take pupils for training in marine engineering. He accepted these offers to a limited extent, particularly favouring Turkish pupils. He afterwards constructed the engines of several Turkish gunboats, as well as several lots of propelling-machinery for the Egyptian and other governments. He also designed and constructed the engines of some British gunboats, among them the "Pandora," which was afterward purchased by Mr. (now Sir) Allen Young, for the purpose of arctic exploration. On this occasion the "Pandora" was put into Mr. Summers's hands for a complete re-equipment for arctic work. Mr. Summers played an important part in connection with ocean steam-navigation, particularly as regards the Peninsular and Oriental, the West India, the Union, the Hamburgh American and the North German Lloyd Companies. He built steamers for the three first-named companies and engined many vessels for all of them, besides doing a large amount of work for the British and foreign governments, and for private owners. Among the fine mail steamers built at Northam were the "Nile," "Allemania," "Surat," "Syria," and "Hindostan"; while the 800 HP. engines of the West Indian mail steamer "Seine" were, when they were constructed some thirty years ago, considered to be of the first importance. At the commencement of his career the "Great Eastern" was found to be deficient in a number of minor details of machinery, &c., and was put under Mr. Summers's charge for alterations, during a period of six months, while in Southampton Water. When the compound-marine engine was brought into practical use, Mr. Summers urged upon the before-mentioned companies the advisability of converting their existing machinery to the compound system, and scores of engines averaging 3,000 HP. were altered by him to the then new and economical system. He was very successful in this description of work, and the repute of the Northam Ironworks has been maintained in later years in the process of converting compound into triple-expansion engines. Mr. Summers took great interest in the form of the screw-propeller, and where circumstances permitted would chip and file a propeller until it attained to a true helix with a smooth surface.

The Peninsular and Oriental, and other large companies, recognizing the value of his form of propeller, ordered many of the Southampton firm. His solicitude for details and for scientific principles becoming known in the United States, Messrs. Winans, about the year 1874, entrusted him with the building of the machinery of their two "Cigar Ships," which were designed to cross the Atlantic in six days. Special machinery of the most efficient kind was put in these vessels, and they obtained, for those days, very promising results. The owners, however, for ulterior reasons maintained secrecy as to the vessels, and in the meantime the pioneer "Greyhounds of the Atlantic," such as the "Arizona" made their appearance with their equally high speed and comfortable deck cabins, which were wanting in the cigar ships. The latter are still afloat in Southampton Water, awaiting their opportunity. It is interesting to note that their designers and owners were very sensible of the importance of surface-friction, and in addition to chipping and filing the propellers, the same process was applied to the entire submerged hulls of the vessels, which were flush-built and afterwards coated with black lead.

In the earlier part of his career, Mr. Summers invented and patented a steam-pressure gauge, of which he made a sufficient number to more than pay the expenses of patenting; but the appearance of Bourdon's gauge for higher pressures rendered Mr. Summers's instrument obsolete. Later, he patented his well-known sheer-legs for lifting very heavy weights; these speedily came into universal favour, and he constructed them for every civilized government in the world, as well as for private dock companies. Some of these were sufficiently powerful to lift the complete turret out of a ship of war.

In the early days of surface-condensation, when the Peninsular and Oriental Company had abandoned it on account of the effect of the fatty acids on the brass tubes, Mr. Summers introduced the plan of tinning the tubes, which was immediately resorted to, and has since been followed with complete success. It is unknown whether Mr. Summers was the actual inventor of this process, but in any case considerable credit is due to him for his efforts to promote its introduction. As an instance of the confidence felt in Mr. Summers's strict integrity, it may be recorded that when he was on the point of retiring from business, he was asked by the Peninsular and Oriental Company to look at the boilers of the newest addition to their fleet, which had failed on the vessel's maiden trip from the builder's yard to London. By the same post he received an invitation from the builders to act in a similar

capacity on their behalf. On informing the parties that he had been engaged by both, he at once received a reply from each to the effect that they would accept his decision, and begging him to act for both sides. Inspection of the boilers revealed the fact that the high pressure had caused leaks in nearly every part. Thereupon Mr. Summers rendered his decision against the builders and prescribed the alterations to be carried out. The award was cheerfully accepted, although it involved a cost to the builders amounting to the supply of almost entirely new boiler-shells.

In 1884 Mr. Summers retired from business, and thereafter occupied himself in various less exacting avocations. He became a director of the Southampton Floating-Bridge Company, of the Southampton and Isle of Wight Steam Packet Company, of the South Hants Waterworks Company, of the Southampton Chamber of Commerce, and a Governor of the Royal South Hants Infirmary. He was elected a Member of the Institution on the 1st of March, 1864, and was also a member of the Institution of Naval Architects. With rare professional attainments Mr. Summers united an amiability and kindness of heart that rendered intercourse with him a real pleasure. This typical Englishman died on the 22nd of March 1889, and his funeral was a quasi public one, at which all the more prominent of his fellow-citizens were represented.

JOHN PAGAN was born at Maxwelltown, Dumfriesshire, on the 21st of May, 1842. In 1860 he was articled for five years to Mr. George Mackay, County Surveyor of Invernesshire, with whom he remained, as pupil and assistant, for seven years. In 1867 he became an Assistant Surveyor to the Corporation of Preston, and held the appointment for two years, when he was promoted to a similar office under the Corporation of Bradford. His career at Bradford was a busy one, for it embraced the period of the important street improvements carried out during the years 1869–72, which quite transformed the leading thoroughfares of that borough. In 1872 Mr. Pagan became Deputy Borough Surveyor to the Corporation of Sheffield, and held the position until 1875, when he was unanimously, and without previous canvassing on his part, selected for the office of Borough Surveyor of Wakefield. As holder of this office he was responsible for several works of interest in municipal engineering, among the most important being the main sewerage extension of the borough, and ventilation and improvement of the outfall. In the early part of 1879 the office of Borough Surveyor of Bradford became vacant, and Mr. Pagan had