

Captain Johnstone did this in its best sense, the testimony of his superior officers abundantly shows. Mr. Cheyne, the superintending engineer of the Holkar State Railway, under whom he served, writes concerning his charge of the Ghât subdivision (Vindya Range):—"The works were of unusual magnitude, and his management was excellent. When the line was nearly finished, I walked over it with General (then Colonel) C. Pollard, R.E., who, saying that he had seen nearly all the public works in India, declared that there was nothing to be found anywhere so fine. I myself do not think it would be possible to do anything better."

After much laborious and hardly requited toil—after years of disheartening yet valuable work—Captain Johnstone had attained such a position that the future was, humanly speaking, in his hands. While his talents were of a high order, his acquired knowledge was great. In everything he was thorough and honest: work entrusted to him was executed most conscientiously. During a tour in Kashmir he collated a mass of valuable notes which he intended to put together to form a complete guide to the traveller in that country. He had contemplated the publication of his Kashmir notes while in England, but this and other plans for occupying a short furlough were frustrated by his untimely death. Captain Johnstone was elected an Associate of the Institution on the 7th of December, 1875.

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MR. ANGIER MARCH PERKINS was born at the end of last century at Newbury Port, a small town in the State of Massachusetts, America. He was the second son of Mr. Jacob Perkins, for many years a member of the Institution,<sup>1</sup> and who distinguished himself through a long and active life by his scientific attainments, and by the number and variety of his inventions. Mr. A. M. Perkins inherited much of his father's talent and fertility of invention, as evidenced by the numerous patents granted to him between the years 1831 and 1864. He came to England in 1827, and was for some time associated with his father in perfecting and bringing to maturity several of the many inventions then in hand. Of these the following may be selected as illustrating the diversity of the inventions which the elder Mr. Perkins gave to the world, and in which the subject of this memoir was closely allied. First, a mode of engraving on steel,

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<sup>1</sup> *Vide* Minutes of Proceedings Inst. C.E., vol. xxv., p. 516.

and of multiplying copies of the engraved plates by transferring the same to other plates under mechanical pressure. Second, a mode of generating and using steam under very high pressure. The former of these inventions led to the establishment of manufactories both in England and in America, which are still in successful operation, for the production of bank notes and such documents in which security from forgery is important, and when a very large number of impressions is required. The invention occasioned much sensation among engravers at the time, owing to the revolution it effected in the mode of engraving by the substitution of steel for the copper-plates previously used; and it may be interesting to mention that the first adhesive postage stamps were produced by this process for all the countries of the world where the system of cheap uniform postage had been adopted.

The latter invention, viz., that relating to the generation and use of high steam, was popularly exemplified by the celebrated "steam gun." It was shown how steam might be safely and practically generated up to 2,000 lbs. pressure per square inch, and could then be kept under perfect control. This subsequently led to other and most important discoveries in connection with the use of steam at higher pressure than theretofore.

Following out the high-pressure system, Mr. A. M. Perkins applied the principle to a mode of heating dwellings and buildings by hot water circulating in closed pipes of small diameter, which has been extensively adopted. A large and successful business was the result of this patent, in the conduct of which Mr. Perkins greatly occupied himself. He nevertheless continued to carry on experiments with high-pressure steam under various conditions and for various purposes. His patent in 1843 for the manufacture and melting of iron by the use of superheated steam was remarkable, inasmuch as it evidently contained in it the germs of the subsequent discoveries relating to the conversion of iron into steel, and the elimination of phosphorus and sulphur from iron.

Later on the system of circulating water in closed pipes of small diameter, heated up to 2,000 lbs. per square inch of steam pressure, was applied by Mr. Perkins to the heating of ovens for baking purposes, which has also been extensively adopted; the uniform degree of heat at which the oven is thereby maintained being of essential benefit. An indestructible engine-boiler on the same system followed, in which the boiler is removed from contact with the fire, the heat from which is conveyed to the boiler by water circulating in closed pipes; and boilers constructed on this principle have been in continuous use for thirty-five years without

deterioration. The instances in which Mr. Perkins' attention to details, combined with his inventive powers, have rendered service to the mechanical world, by some simple contrivance, are very numerous. Few of these were the subject of patents, but the right and left hand-screw joint, which was patented by him, will be admitted to have been of essential service, especially in connection with hydraulic work. As a mode of uniting the ends of two pipes, and forming a tight joint, capable of bearing as much pressure as the pipe itself, it is at once simple and excellent. It may be added that during the whole course of the working with very high-pressure steam, from its commencement to the present time (a period of fifty years), no dangerous accident has happened nor has any life been lost.

Naturally of a retiring disposition, and with much occupation on his hands, he successfully resisted the frequent appeals of his many friends that he would take a more prominent place among his professional brethren, and give them the benefit of his great experience and undoubted abilities. Those, however, who had the privilege of his intimacy and friendship can bear testimony to the enjoyment they experienced in their intercourse with him, no less from his unaffected kindness than from the store and accuracy of the knowledge which he was so well able to communicate. He died on the 22nd of April, 1881, at the advanced age of eighty-one.

Mr. Perkins was elected an Associate of the Institution on the 5th of May, 1840.

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MR. EDWARD ANTOINE SACRÉ was born in London on the 8th of October, 1838. In early life he pursued his studies in London and Belgium with a view to becoming an engineer. In 1853 he was articulated to Mr. Archibald Sturrock, at that time Locomotive Superintendent of the Great Northern Railway, and went through the various practical departments of that railway. He soon showed so much quickness and ability, that Mr. Sturrock was induced to employ him frequently in making experiments on the consumption of coal, coke, water, &c., in locomotive engines; also in regard to the general loading of trains, more particularly in the goods and mineral service. On the termination of his pupilage he was appointed assistant to Mr. Budge, the District Locomotive Superintendent of the Great Northern Railway, at King's Cross, where he gained such experience that, on the opening of the East Kent, now the London, Chatham, and Dover Railway, he was appointed