

ready to support other mining and industrial enterprises, especially in the North of England; and not only was he a large shareholder, but he took an active part in the management of iron, coal, lead, and copper mining properties and works in England, Portugal, Algeria, Bohemia, &c.

Mr. Joicey was a Justice of the Peace for both the counties of Northumberland and of Durham, and a Deputy Lieutenant of the latter county, for which in 1878 he was High Sheriff. In April 1880 he was elected one of the representatives in Parliament for the Northern Division of Durham, and so continued to his death, which occurred, after a comparatively short illness, at his seat, Newton Hall, Stocksfield-on-Tyne, on the 15th of August, 1881, in the sixty-fifth year of his age. He was interred on the 19th of the same month at Newton church, which he had a few years before erected and endowed.

As one of the representatives of the Coal Owners, Mr. Joicey was a River Tyne Commissioner, and held office in, and was a warm supporter of, many of the educational, scientific, and philanthropic institutions in Newcastle and the neighbourhood. This was evidenced in a remarkable degree by the fact that, in 1881, he contributed the munificent sum of £12,000 to the Museum of the Natural History Society of Northumberland and Durham.

Mr. Joicey's goodness of heart, kindness of disposition, and great liberality were well and widely known, and evidenced by his support of every movement having for its object the promotion of science, art and education, and the social advancement and substantial improvement of all classes of society.

Mr. Joicey was elected an Associate of the Institution on the 2nd of March, 1875.

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SIR WILLIAM PALLISER, C.B., M.P., was the fifth son of the late Wray Palliser, Esq., of Comragh, County Waterford, Lieut.-Colonel of the Waterford Artillery Militia, by his wife Anne, daughter and heiress of John Gledstones, Esq., late of Anne's Gift, County Tipperary. He was born in Dublin on the 18th of June, 1830, and was educated at Rugby and at Trinity College, Dublin, whence he migrated to Trinity Hall, Cambridge, and finally passed through the Staff College at Sandhurst. In April 1855 he entered the Rifle Brigade as ensign, and went to the Crimea. He served on the staff of Sir William Knollys, when commanding at Aldershot, and afterwards as Brigade Major of Cavalry in Ireland.

In 1858 he was transferred to the 18th Hussars, became Captain in August of the following year, Major unattached in October 1860, and sold out of the army in December 1871.

Sir William Palliser appears to have turned his attention to gunnery as early as the year 1853, before he left Cambridge, and to the last day of his life was actively engaged in improving guns and ammunition. In 1853 several projectiles of his were fired at Shoeburyness, then quite an infant establishment. In 1855 a 7-inch rifled mortar was tried with great success in presence of Captain Sir Thomas Maitland, of H.M. gunnery ship "Excellent" at Portsmouth. The first invention that brought Sir William's name prominently forward, and made it, indeed, a household word among military men throughout the world, was his chilled shot and shell. Not only did he conceive the idea that chilled cast iron would prove competent to pierce armour, but he worked out the process of manufacture in detail, and fixed the exact form of head which would prove most efficient. The only substitutes for the "Palliser projectiles" are shot made of steel, turned and bored out of forged ingots, at a cost of about five times greater than that of Palliser missiles; and even then it has recently been found that forged steel shot of larger calibre than 7 inches is uncertain in temper, and therefore untrustworthy. The proper form of point occupied Sir William up to the time of his death, for when that unlooked-for event took place he was engaged in experiments with shot having very elongated ends armed with sharp chilled ridges, intended to determine lines of fracture in the compound armour against which they were fired. In order to prevent the tendency which exists of the shot setting up, and even crumbling to pieces about the middle of its length, when suddenly arrested in its flight, he reduced the diameter of the casting and shrunk on a wrought iron or steel jacket, the ribs on the pointed head coming up to the full diameter. Experiments at Erith on small missiles fired against compound armour-plates, gave very encouraging results, and larger shot was in course of manufacture at the time of his death. Sir William Palliser's patents for chilled shot were yielding a moderate income when they expired. He applied for an extension of these patents, but, although the Government had free use of these inventions, he was most unexpectedly and successfully opposed by the War Office, and deprived in a single afternoon of the fruits of long labours and costly experiments by which the nation had benefited so largely. The vexation and disappointment these proceedings entailed undoubtedly undermined his health.

Sir William devoted much time and money to investigating the relative merits of wrought iron and steel for the linings of rifled guns, and for armour plate bolts. He held the opinion that the harder and stronger qualities of steel were unfit to resist sudden shocks, and were therefore unsuited to such uses. He advocated the adoption of wrought-iron liners for guns, and did inestimable service in suggesting the boring-out of the old smooth-bore cast-iron guns, and converting them into rifled ordnance, by inserting wrought-iron tubes comparatively loosely driven in. He considered that tubes so fitted would, by their elasticity and ductility, absorb a good deal of the work of the explosion before it reached the cast-iron casing. Many thousands of the "Palliser converted guns" are scattered over this country and the colonies, and are used almost exclusively for artillery practice by the Volunteers. No single accident from the bursting of a gun has ever occurred.

Sir William took an active part in the controversy respecting the bursting of the "Thunderer's" gun. He was of opinion that there had been no double loading, and that the gun burst from inherent weakness, due to the use of a steel liner and massive wrought-iron coils, which changed the strength of the gun by too rapid gradations. He considered, in accordance with Chernoff's theory, that large masses of wrought iron kept for a long time at a high temperature gradually become crystalline and lose most of their tenacity, and that the hard steel tube cracked under the effect of successive explosions. To demonstrate the truth of these views he instituted some remarkable experiments at the Erith Ironworks on double-loaded ordnance. A 32-pounder smooth-bore cast-iron gun converted into a 64-pounder rifled-gun was repeatedly fired with double charges gradually increasing in weight till at last the gun cracked, but did not burst destructively. A 64-pounder converted-gun was similarly tested, and at last burst under a heavy double charge of quick burning powder; the pressures registered by the crusher gauges amounted to 44 and 47 tons per square inch before destruction took place. Sir William claimed, not unreasonably, that his converted ordnance excelled in strength the costly guns manufactured on the Woolwich system. The American and Canadian Governments satisfied themselves by exhaustive experiments on the soundness of the system, and have adopted it for the largest calibres.

In conjunction with Captain English, R.E., Sir William made important improvements in the form of bolts used for the purpose of securing armour plates to the sides of vessels and batteries. At the time of his death he was engaged in constructing two long

7-inch breech-loading guns for the Canadian Government. In deference to popular prejudice he determined to use cast steel casings instead of cast iron, and a movable breech screw, but with a continuous thread which he believed would be better able to resist severe work than the interrupted thread. To test this thoroughly he altered a 64-pounder converted-gun into a breech-loader on the system proposed, and fired it successfully at Erith under heavy charges.

All Sir William's late experiments—and they were necessarily of a costly character—were conducted at his own expense, and he was ever ready to impart the extensive practical knowledge he possessed to all interested in the art to which he had devoted his life. His services were rewarded by Her Majesty conferring on him in 1868 the Companionship of the Bath, and in 1873 the dignity of Knighthood; while the King of Italy, in 1875, bestowed on him the Cross of a Commander of the Crown of Italy. He contested Devonport and Dungarvon unsuccessfully, but was returned in the Conservative interest for Taunton at the last general election.

Besides the matters of national interest already enumerated, Sir William Palliser was engaged in several commercial enterprises, especially in the laying out of the Cadogan and Hans Place estates, near Sloane Street. The houses here erected, from the designs of several of the leading architects, have done much to redeem the architecture of London from the low state to which it had fallen. Sir William's character was frank, genial, and winning in the extreme, so that all who could claim the privilege of his acquaintance must mourn the loss of a man of singular originality of views, as well as a kindly and accomplished English gentleman.

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MR. CHARLES TOMLISON was born on the 6th of January, 1835, at Walton-le-Dale, in Lancashire, and was educated by his father, the late Mr. James Tomlison. At an early age he was placed with his uncle, Mr. Robert Anderton, then the General Manager of the Preston Water Works. It was here that he acquired that intimate knowledge of the works necessary for the efficient distribution of water under the Constant Service System, which he afterwards turned to good account in numerous towns throughout the kingdom. He remained at the Preston Water Works until 1856, when he became General Manager of the Wolverhampton New Water Works, Mr. J. F. Bateman, Past-President