

Science in Westminster Abbey.

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THE ceremony of unveiling a memorial in Westminster Abbey to the memory of the late Lord Rayleigh, which was held yesterday, November 30, may perhaps lend interest to a short account of the memorials to men of science already there. These memorials are more numerous than is generally supposed. There are few branches of science unrepresented, and in some directions the scientific activity of the nation is faithfully reflected by the men either buried or commemorated within the Abbey walls. Though interments have taken place in the Abbey for many centuries, it is only within the last two hundred years or so that any man of science has been buried there. The earliest British representative of science commemorated is the young astronomer, Jeremiah Horrocks, who died in 1641, a year or two after he had watched the transit of Venus. Astronomy is further represented by Adams and Sir John Herschel, but it is rather surprising that none of the Astronomers Royal—Flamsteed, Halley, Bradley, Maskelyne, or Airy—is commemorated. Mathematics and physics can show memorials to Barrow, Newton, Spottiswoode, Thomas Young, Joule, Stokes, and Kelvin; geology is represented by Woodward, Buckland, and Lyell; chemistry by Sir Humphry Davy; while Darwin, Wallace, and Hooker are the three outstanding naturalists. Surgery, medicine, and engineering all have memorials of interest, and to some of these brief reference will be made.

The first man of science of note to be buried in the Abbey was Sir Robert Moray, who played a very important part in the foundation of the Royal Society, and held the office of president up to the time of its incorporation. His grave is in the south transept. In his younger days an officer in the French army, Moray was royalist to the core, and received his knighthood from Charles I. He was also a favourite with Charles II., and though it is said that he "had no stomach for public employment," he served his Sovereign in various capacities. Of him Wood said that he was "a renowned chymist, a great patron of the Rosicrucians, and an excellent mathematician," while Burnet pronounced him "the wisest and worthiest man of the age." Moray is among the first of many fellows of the Royal Society commemorated in the Abbey, and the first of several presidents buried there. It was he who proposed Hooke as curator to the society. He died suddenly, July 4, 1673, in his pavilion in the gardens of Whitehall, and his funeral was carried out at the expense of Charles II.

Two years later the Abbey witnessed the interment of Thomas Willis, who as a young bachelor of medicine at Oxford had taken part in the meetings of the philosophers at the lodgings of Wilkins, Petty, and Boyle. Like Moray, a staunch royalist, at the Restoration he was made Sedleian

professor of natural philosophy in the place of the ejected Joshua Crofts. Afterwards he gained much celebrity as a London doctor, his fame being such that it was said "that never any physician before went before him or got more money yearly than he." His death took place in his house in St. Martin's Lane, November 11, 1675, and a week later he was buried beside his wife in the Abbey, "an honour which he well deserved on account of his anatomy of the brain and the discovery of saccharine diabetes." The cost of his funeral is given at 470*l*.

In 1677 the Abbey saw the burial of Isaac Barrow, the celebrated mathematician and divine. First to hold the Lucasian chair of mathematics at Cambridge, Barrow in 1669 had resigned in favour of his pupil, Newton, and during the last three years of his life was master of Trinity. He died on May 4, and was buried not far from Moray in the north transept—now known as Poets' Corner. "He had come," says Stanley, "as master after master had come, to the election of Westminster scholars, and was lodged in one of the canonical houses 'that had a little stair to it out of the cloisters' which made him call it 'a man's nest.' He was there struck with high fever and died from the opium which, by a custom contracted when at Constantinople, he administered to himself." Another account says he died "in a mean lodging at a saddler's near Charing Cross." Moray, Wallis, and Barrow appear to be the only men of science buried in the Abbey during the seventeenth century.

The majority of the graves and monuments to men of science are found in the nave and the north aisle. Best known of all is the monument to Newton in the screen of the choir. Of the long inscription upon it Johnson said: "Had only the name of Sir Isaac Newton been subjoined to the design upon the monument instead of a long detail of his discoveries, which no philosopher can want, and which none but a philosopher can understand, those by whose direction it was raised had done more honour both to him and themselves." The gravestone close by bears the words: "Hic dispositum est quod mortale fuit Isaaci Newtoni." Voltaire was at Newton's funeral, and afterwards wrote: "Newton was honoured as he deserved to be both in his lifetime and after his death. The chief men of the nation contended for the honour of bearing the pall at his funeral. Go into Westminster Abbey; admiration is not paid to the tombs of the kings, but to the monuments which the gratitude of the nation has erected to the greatest men who have contributed to its glory. Their statues are to be seen there like those of the Sophocles and the Platos at Athens, and I am convinced that the mere sight of these glorious monuments has stimulated more than one spirit, and has formed

more than one great man." It is from Voltaire we have the story of Newton and the apple. He was in England from 1726 to 1729, and he learned it from Newton's niece, Mrs. Conduitt.

Buried next to Newton is his great successor, Lord Kelvin, while a little farther towards the centre of the nave are the graves of Telford and Robert Stephenson. Thomas Telford, designer of the suspension bridge over the Menai Straits, engineer of the Caledonian Canal, first president of the Institution of Civil Engineers, "a fellow of infinite humour and of strong, enterprising mind," died at 24 Abingdon Street, Westminster, on September 2, 1834, and was buried in the Abbey on September 10. Twenty-five years later Robert Stephenson, at his own request, was buried beside him. Both are commemorated elsewhere in the Abbey, Telford by a statue, Stephenson by a window. Still nearer the centre of the nave, and not far from the spot hallowed to-day as the resting-place of the "Unknown Warrior," is the common grave of Thomas Tompion (1639-1713), "the father of English watch-making," and his successor, "honest George Graham" (1673-1751), who constructed astronomical instruments for Halley and Bradley, and "whose inventions do honour to ye British Genius, whose accurate performances are ye standard of mechanic skill." The present tombstone was removed in 1838, and for some years, until Dean Stanley replaced it, Graham's grave was marked only by a plain lozenge-shaped stone. At the west end of the nave is the memorial to John Conduitt (1688-1737), who married Newton's niece and succeeded him at the Mint. It is within Conduitt's monument that a tablet was placed some forty years ago to commemorate the brilliant work of the young Lancashire clergyman, Jeremiah Horrocks.

Of no less interest than the nave is the north aisle, the windows of which commemorate the work of Richard Trevithick (1771-1833), most fertile of inventors, and, like Hedley, Blenkinsop, and George Stephenson, one of the fathers of the locomotive; the younger Brunel (1806-59), who lived just long enough to see the completion of his greatest works, the Albert Bridge at Saltash, and the "Great Eastern"; Sir Benjamin Baker (1840-1907), joint engineer with Fowler of the Forth Bridge; Joseph Locke (1805-60), one of the greatest of railway engineers; Robert Stephenson (1803-59), constructor of the London to Birmingham railway, designer of many famous bridges, and, like Baker and Locke, president of the Institution of Civil Engineers; Lord Kelvin (1824-1907), the greatest of modern physicists, who redeemed the Atlantic cable from failure and showed the possibility of utilising the power of Niagara; and Sir William Siemens (1823-83), electrician and metallurgist, a pioneer of the dynamo, and the inventor of the regenerative furnace, and president of the Institution of Mechanical Engineers.

Beneath these windows are the monuments to John Woodward (1665-1728), professor of physic

at Gresham College, founder of the chair of geology at Cambridge, and author of an "Essay towards a Natural History of the Earth"; the grave of, and monument to, Sir Charles Lyell (1797-1875), "the founder of English geology"; and near the spot where Ben Jonson was buried upright in a space 2 ft. by 2 ft.—all he asked for—is the grave of John Hunter (1728-93), the great anatomist. Originally buried in the vaults of St. Martin's-in-the-Fields, Hunter's coffin was brought to light by Frank Buckland as the result of a unique example of "chivalrous devotion to the relic of a great man." At the close of the afternoon service in the Abbey on March 28, 1859, in the presence of the president and fellows of the Royal College of Surgeons, Hunter's remains were re-interred among those of his peers. A little past the monument to Richard Mead (1673-1754), "prince of English physicians," who attended Newton in his last illness, and with whom Woodward fought a duel in the entrance to Gresham College, are found the graves of Darwin and of Sir John Herschel, "the prose poet of science," whose vow "to try and leave the world wiser than he found it" was amply fulfilled by a life full of the noblest effort.

Further to the east, just within the aisle of the choir, and grouped about the tomb of Lord John Thynne, fifty years a canon of Westminster, are the memorials to Adams, Stokes, Hooker, Wallace, Darwin, Lister, and Joule. Most of these memorials are portrait medallions, but that to Joule is a tablet, the inscription upon which states that it was erected "in recognition of services rendered to science in establishing the law of the conservation of energy and determining the mechanical equivalent of heat," achievements which, in the words of Tyndall at the Jubilee of 1887, formed "the largest flower in the garland which the science of the last fifty years is able to offer to the Queen." Mention must also be made of the statue close by of Sir Stamford Raffles (1781-1826), founder of the colony of Singapore and the first president of the Zoological Society.

Standing at the angle of the choir—now known as Science Corner—close to the grave of Darwin, with the graves of Newton and Kelvin to the south and the windows to the engineers to the north, in full view of the memorials of Darwin, Stokes, and Lister, it may be questioned whether there exists another spot which recalls such high endeavours, such lofty aims, such devotion to the search for truth and the spread of knowledge. The Abbey here is a veritable temple of science rivalling in interest the Statesmen's Aisle, the tombs of Plantagenets and Tudors, and even the Poets' Corner. Here are commemorated those whose guiding star was: "Prove all things; hold fast to that which is good." Here indeed are some to whom apply the words: "A wise man shall inherit glory among his people, and his name shall be perpetual."

The south aisle contains four monuments of scientific interest, the men commemorated being

Martin Folkes (1690-1754), president of the Royal Society for eleven years; John Freind (1675-1728), who while imprisoned in the Tower began his "History of Physic," and whose release was a condition laid down by Mead when prescribing for Sir Robert Walpole; Thomas Sprat (1635-1713), Bishop of Rochester and first historian of the Royal Society, who concluded his dedication to the King: "Your Majesty will certainly obtain immortal fame for having established a perpetual succession of inventors"; and William Buckland (1784-1856), the well-known Dean of Westminster and early president of the Geological Society. In the early days of Buckland at Westminster his son, Frank, the discoverer of Hunter's coffin, climbed the roof of the nave and by means of a long pendulum suspended from it repeated Foucault's experiment for showing the rotation of the earth.

Besides the graves of Moray and Barrow already referred to, the south transept contains a monument to Stephen Hales (1677-1761), "pious, modest, indefatigable, and born for the discovery of truth," known to-day for his work on animal and vegetable physiology; and another to Sir John Pringle (1707-82), reformer of military medicine and the predecessor of Banks as president of the Royal Society. It was he who, when the world of science was torn asunder by the controversy over the pointed ends (Franklin's) and the blunted ends (Wilson's) of lightning conductors, made the reply to George III.: "Sire, I cannot reverse the laws and operations of Nature." Buried here is also Sir William Spottiswoode (1825-82), who died while president of the Royal Society.

Only a few more memorials remain to be noticed. Among these, however, is that of Watt. Of all the monuments within the Abbey none has called forth more criticism than Chantrey's great work which dominates the little chapel of St. Paul. "Well might the standard-bearer of Agincourt," wrote Stanley, "and the worthies of the Courts of Elizabeth and James have started from their graves in St. Paul's Chapel if they could have seen this colossal champion of a new plebeian art

enter their aristocratic resting-place and take up his position in the centre of the little sanctuary, regardless of all proportion or style in all the surrounding objects. Yet when we consider what the vast figure represents, what class of interest before unknown, what revolutions in the whole actual framework of modern Society, equal to any that the Abbey walls have yet commemorated, there is surely a fitness in its very incongruity." Of Brougham's inscription Stanley said: "It is not unworthy of the omnigenous knowledge of him who wrote it or of the powerful intellect and vast discovery which it is intended to describe."

Watt's great contemporary, Telford, is commemorated by a statue in St. Andrew's Chapel, and here are also to be found the memorials to Matthew Baillie (1761-1823), pupil and successor of William Hunter, physician to George III., and president of the Royal College of Physicians; Sir Humphry Davy (1778-1829), discoverer of potassium and sodium, and inventor of the miner's safety lamp; Thomas Young (1773-1829), founder of physiological optics, and called by Rankine "the most clear-thinking and far-seeing mechanical philosopher" of his time; and lastly that to Sir James Young Simpson (1811-70), the great Edinburgh surgeon, by whose efforts "the fierce extremity of suffering has been steeped in the waters of forgetfulness." It is here, between the statues of Telford and of Mrs. Siddons, and above the memorials to Baillie and Davy, that the tablet to Lord Rayleigh has been placed. The chapel itself forms part of the aisle of the north transept, to which entrance is gained through the gates of the Ambulatory. Sir John Franklin, Admiral McClintock, who discovered the relics of the Franklin expedition, and Admiral Kempenfelt, all have their monuments here, while across the transept can be seen the window erected to the memory of the officers and men who were drowned in the Bay of Biscay through the capsizing of H.M.S. *Captain*, an eloquent reminder of the necessity of making adequate scientific research before embarking upon a great practical experiment.

The Nitrogen Problem.¹

THE results of a detailed examination of the problem of nitrogen fixation were given in the comprehensive Final Report of the Nitrogen Products Committee of the Ministry of Munitions, published in 1920, and already noticed in these columns (vol. 104, pp. 533 and 569; vol. 105, p. 201). As the Ministry of Munitions is no longer in existence, the Department of Scientific and Industrial Research has arranged for the publication of the additional statistical information which has been accumulated since that time. This Supplementary Report has been drawn up by Dr. J. A. Harker, the director of the Nitrogen Re-

search Laboratory under the Ministry of Munitions. It deals with the statistical aspect of the Chile nitrate industry, the saltpetre industry, the nitric acid industry, the ammonium sulphate industry, the synthetic ammonia industry, the Norwegian fixation industry, the cyanamide industry, the ammonia oxidation industry, and the fertiliser industry. It includes, in addition, a variety of miscellaneous statistics relating to the world's production of fixed nitrogen, national internal sources of fixed nitrogen, the world's fixation plants and power requirements, and the prices of nitrogen fertilisers in England and Germany. The whole concludes with a reference to the present position of nitrogen fixation in this country.

One of the most remarkable of post-war experi-

¹ Statistical Supplement to the Final Report of the Nitrogen Products Committee of the Ministry of Munitions. Department of Scientific and Industrial Research. (Published by H.M. Stationery Office, 1921.) 1s. net.