

MEMOIRS OF DECEASED MEMBERS.

THE REV. ROBERT WILLIS,¹ one of the last of the brilliant circle of Cambridge professors, who, from the varied nature of their acquirements, were the glory of their University during the middle period of the present century, was born in London on the 27th of February, 1800. His father was Dr. Robert Darling Willis, Physician to George III., celebrated not only for his skill in restoring the king to health, but also for introducing, in conjunction with his brother, Dr. John Willis, that modern treatment of insane persons which substitutes gentle measures and cheerful surroundings for the system of restraint and cruelty formerly in vogue. As a child, Robert Willis's health was so delicate that he could not be sent to school; but he early manifested those tastes which were afterwards destined to distinguish him—becoming a skilful musician, a good draughtsman, and a most eager explorer of every ancient building that came in his way. When only nineteen years of age he took out a patent for an improvement to the pedal harp. In 1821 he became a pupil of the Rev. Mr. Kidd, of King's Lynn, and in the following year entered himself at Caius College, Cambridge, where he graduated B.A. as ninth wrangler in 1826. In the same year he was elected 'Frankland Fellow' of his college, becoming 'Foundation Fellow,' on the 9th of May, 1829. Mr. Willis now devoted himself to subjects in which pure mathematics were blended with physics and animal mechanism, to the last a favourite study with him. His papers in the Transactions of the Cambridge Philosophical Society, "On Vowel Sounds and on Reed Organ Pipes" (1829), and "On the Mechanism of the Larynx" (1832), amply testify to his acquirements in this branch of science. In 1830, Mr. Willis was made a Fellow of the Royal Society, and in the following

¹ The substance of this memoir is taken from a notice by Mr. J. W. Clark, nephew of Professor Willis, in the "Cambridge Chronicle," March 6, 1875, supplemented by professional details contained in an account of Professor Willis's life and works published in the "Newcastle Daily Chronicle" for August 27, 1863, during the meeting of the British Association; and in the "Architect" of March 6, 1875.

year became one of the original members of the British Association, which had just begun its career under the presidency of Earl Fitzwilliam. In this capacity he prepared a report on the then state of knowledge concerning the phenomena of sound, which was delivered orally at the meeting at Oxford in 1832. In 1837, Mr. Willis, without opposition, succeeded the Rev. W. Farish as Jacksonian Professor. Mr. Jackson's very curious will insists that his "lecturer, professor or demonstrator shall be the person best qualified by his knowledge in natural experimental philosophy, and the practical part thereof, and of chemistry, to instruct the students." The choice of subject is therefore practically left to the holder of the office for the time being, and Mr. Willis chose, as his predecessor had done, Applied Mechanics. His practical knowledge of carpentry and machinery, his inventive genius, and his power of lucid exposition made him a most attractive Professor, and his lecture-room was always crowded. No matter how dry the subject, he knew how to make it interesting; and whether he discoursed of rope-making or the organ, on joints or the Jacquard loom, he held his audience spell-bound, and dismissed them charmed alike with the knowledge they had gained, and the pure English in which it had been conveyed to them. In these lectures he first separated the principles of motion and force, in which course he was shortly afterwards followed by Dr. Whewell. His views on this subject were further developed and elaborated in his celebrated "Principles of Mechanics," which at once took its place as the most complete treatise that had yet appeared on the science of machinery, and raised its author to the highest rank as a mechanical philosopher.

In 1837, Professor Willis read to the British Association a valuable paper on the Teeth of Wheels;¹ and in the following year the subject was elaborately treated in a paper read by him before this Institution, when he produced his well-known 'odontograph.'² Although the investigation of the proper curves to be given to the cogs of wheels had long been a favourite pursuit of mathematicians, Willis nevertheless pointed out new forms possessing more general properties than any which had been previously employed. The odontograph is now very generally employed for enabling workmen to find at once the centres from which the two portions of the teeth are to be struck, so that they may work together truly.

¹ *Vide* Report of the British Association for 1837, p. 152.

² *Vide* Trans. Inst. C.E., vol. ii., p. 89.

In 1849, a Royal Commission was issued to inquire into the application of iron to railway structures; and of this commission Professor Willis was appointed a member, Lord Wrottesley, Captain (now Sir Henry) James, Mr. George Rennie, Mr. (afterwards Sir) William Cubitt, and Mr. Eaton Hodgkinson, being his coadjutors, with Lieutenant (afterwards Captain) Douglas Galton as secretary. Professor Willis constructed an apparatus by which the phenomena indicated in the experiments were developed and made capable of practical illustration. His mathematical theory showed that the increased pressure produced by the greater velocity of a passing load, highly developed when slender elastic bars were employed, became unimportant in massive structures. This apparatus was subsequently exhibited at the meeting of the British Association in 1849. Professor Willis took an active part in the first Great Exhibition, of which he was one of the jurors, and drew up the report for the class of manufacturing machines and tools. In that capacity he contributed a lecture to the series which was organised by the Society of Arts in 1852. He was also Vice-President of the Paris Exhibition of 1855, and Reporter of the class for the machinery of textile fabrics; and, in connection with this office, published in 1857 a report on machinery for woven fabrics, for which he received the cross of the Legion of Honour from the Emperor Napoleon III. When the Government School of Mines was established in Jermyn Street, in 1853, Professor Willis was engaged as the Lecturer on Applied Mechanics, in which capacity he annually delivered a course of thirty-six lectures, and in every alternate year an additional course of six lectures to working men. In 1851, Professor Willis published a description of a system of apparatus for lecturers on experimental philosophy and mechanism, which he had matured during his own courses of Cambridge lectures; and he was now authorised by the Board of Trade to devise and construct new and improved forms of apparatus for teaching machinery. Many of these improvements are exhibited in the South Kensington Museum.

In 1862, Professor Willis was President of the British Association, which that year met at Cambridge; and in the following meeting at Newcastle, he presided over the mechanical section.

But great as is the indebtedness of the engineering profession to Professor Willis, it is far less than that of its elder sister, Architecture; and it is as an investigator into the architectural history of individual ancient buildings that his reputation will live, when the memory of his achievements in mechanical science may have faded. By profession a clergyman, by position Jacksonian Pro-

fessor of Natural and Experimental Philosophy in the University of Cambridge, he took up the study of architecture as a relaxation, and approached it from the antiquarian's, not the practician's, side. His was essentially an inquiring mind; he was keen in research, acute in observation, and logical in judgment, and his mathematical training qualified him to comprehend and to unravel the complications of constructions of even more than ordinary complexity. His learning as an antiquary, his familiarity with Mediæval Latin, his knowledge of the handwriting of mediæval scribes, and his perseverance in following up the very slightest clue, combined to render him eminently fit to investigate subjects towards which attention had forty years ago been only newly turned. The value of his early work, written during his wedding tour, and published in 1835, called "Observations on the Architecture of the Middle Ages, especially of Italy," must not be measured by its importance to the student at the present day. Other labourers in the same field have produced works which are certainly more modern, but none which are so comprehensive and which go so thoroughly to the root of the matter, dissecting a building as an anatomist does an organism, and laying bare the principles of its construction. If the work should appear at the present day to be somewhat old-fashioned, it should be remembered that Willis laboured on all but untrodden ground; and what he did was done completely and faithfully as far as it went. A subsequent essay on Gothic vaulting, which forms one of the ornaments of the "Transactions" of the Royal Institute of British Architects, may be accepted as a better specimen of the man and his method of working. Here the subject was a limited and a difficult one, and if the whole field is not occupied, that portion at least to which the main part of the essay was devoted is surveyed with an accuracy and a completeness which may be said pretty nearly to have exhausted it. This paper, read in 1842,¹ developed by the help of many years' personal observation and study, indicated the methods pursued by the ancient workmen in shaping the stones. It was followed up by the exhibition before the same body of his 'cymagraph,' an instrument invented by himself to obtain exact drawings of the profiles of existing mouldings. In the two following years he contributed to the Cambridge Antiquarian Society papers "On the Sextry Barn at Ely lately demolished," and "On the Architectural Nomenclature of the Middle Ages." A considerable part of the latter contribution was subsequently incorporated

¹ *Vide* Trans. Inst. Arch., 1842. p. 1.

in the fifth edition of the "Oxford Glossary," of which Professor Willis was the editor. In 1845 he published an elaborate "Architectural History of Canterbury Cathedral." This work was the substance of his discourse the year before to the congress of the Archæological Institute at Canterbury—the first of a series of oral lectures which he subsequently delivered almost every year to the members of that society at their successive congresses. The publication of the "History of Canterbury Cathedral" was followed by the delivery of discourses on the Cathedrals of Winchester, York, Norwich, Ely, Lincoln, Salisbury, Oxford, Wells, Chichester, Gloucester, Lichfield, Peterborough and Worcester, besides one on the "Architectural History of the University of Cambridge," when he held the office of Sir Robert Rede's lecturer in 1861. The last of this series, "On the Architectural History of the Cathedral and Conventual Buildings at Rochester," was delivered in 1863. In 1849, he published "The Architectural History of the Holy Sepulchre of Jerusalem," inserted also in the second edition of Williams's "Holy City." This is by no means an exhaustive catalogue of Professor Willis's contributions to architecture and archæology. Scattered up and down the transactions and the journals of the learned societies, his papers and discourses would fill many volumes. These important inquiries in the domain of architectural archæology obtained for Professor Willis the well-merited honour of the Royal gold medal of the Institute of Architects: and his acquirements in astronomy were such as to lead to his nomination by the President of the Royal Society as Visitor to the Royal Observatory at Greenwich, on the death of his great contemporary Whewell.

Professor Willis was elected an Honorary Member of the Institution of Civil Engineers on the 8th of May, 1838; he was also connected with many other scientific societies. His death occurred from bronchitis, on the 28th of February, 1875, after an illness of a few days.

MR. JOHN WILLIAM BLACKBURNE, eldest son of the late Mr. John George Blackburne, M. Inst. C.E., was born in Oldham on the 3rd of July, 1839, and was educated at Furness. When fifteen years of age, he entered the office of his father, and on the completion of his articles he had acquired considerable experience on the various railways, waterworks, and collieries then under his father's superintendence.

At the beginning of the year 1862, Mr. J. W. Blackburne was

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