Last year flooding and wholesale damage were on a terrible scale, and it may be hoped that the appearance of Mr. Coventry's brochure may pave the way to a better understanding of this serious problem.

The monograph may also be commended to the Colonial Office and its officials. For there are many other parts of the British Empire where the same conditions as Mr. Coventry describes in the Punjab Hills are being produced and by the same agencies. It forms one of the large and pressing problems of the day in such regions.

Obituary.

DR. SEBASTIAN Z. DE FERRANTI, F.R.S.

SEBASTIAN ZIANI DE FERRANTI was born in Liverpool on April 9, 1864, and was educated at Hampstead School, St. Augustine's College, Ramsgate, and at University College, London. Even from his earliest days he showed a great bent towards engineering invention, and before he left school he began to build a dynamo. When he was only seventeen years of age the first Ferranti machine with its coreless disc armature was installed in the arches under Cannon Street Station. In the year 1882 he and Mr. Francis Ince went to Glasgow to interview Sir William Thomson (Lord Kelvin) to try to arrange a working agreement with him, as it was found that one of Thomson's patents partly anticipated Ferranti's invention. An agreement was arrived at, but it placed rather too heavy a burden on their manufacture. In 1883 the firm of S. Z. de Ferranti and Co., the forerunner of the large works at Hollinwood, Manchester, was established at Charterhouse Square. I remember going over this factory so long ago as 1890 and being greatly impressed by seeing hundreds of Ferranti meters all connected in series being tested.

In 1883 the late Lord Crawford and Sir Coutts Lindsay decided to adopt electric lighting at the Grosvenor Gallery in Bond Street. They installed a small plant, but the urgent requests of neighbours led them to enlarge it, and Ferranti was put in charge. He planned 2500 volt overhead conductors and underground mains, and supplied an area extending from Regent's Park to Charing Cross and from Lincoln's Inn Fields to Albert Gate. This was a marvellous feat for that period, but Ferranti's magnetic personality attracted an enthusiastic band of assistants, to whom he used to attribute much of his success. He was soon convinced, however, that Bond Street was not a suitable site for a power station. He saw that in order to supply electricity economically it was necessary to build a large generating station in a place to which coal could be conveyed cheaply, where rents were low, and where abundant water could be had for the boilers and condensers. He visualised that to light London it would be necessary to obtain a site in the suburbs near the river and to transmit electricity to substations at the high pressure of 10,000 volts. The site he selected was at Deptford, some eight miles from the centre of the load, and there he built a great power station, having machinery of more than 40,000 horse-power and generating at 2300 volts. The pressure was then raised to 10,000 volts and transmitted to the substations. The scheme was taken up enthusiastically by Francis Ince, Lord Crawford, Lord Wantage, and others, and the London Electric Supply Corporation, Ltd., was founded.

With practically no previous experience to guide him, as this was the first high-tension station in the world, Ferranti designed by himself generators, transformers, mains, and all the necessary complicated switchgear. Serious difficulties were soon encountered ; amongst others the resonance phenomenon called the Ferranti effect. At this period, when even his strongest supporters began to waver, Ferranti pushed resolutely forward, overcoming difficulty after difficulty, and undeterred by breakdowns until success crowned his efforts. He frequently consulted Sir William Thomson professionally, and the latter found some of his problems of absorbing interest. In particular he computed the effect produced by the rapidly alternating current in increasing the resistance of the Deptford-Trafalgar Square mains.

In 1892, Ferranti resigned his post of engineer to the London Electric Supply Corporation, and devoted himself exclusively to the manufacture of electrical apparatus. His works were finally established at Hollinwood, near Manchester. They supply every kind of apparatus for electric lighting, and their transformers, meters, and radio apparatus are very widely used. In particular Ferranti designed and installed the million-volt transformer which is now in use at the National Physical Laboratory, Teddington.

In 1910, Ferranti gave a remarkable presidential address to the Institution of Electrical Engineers, in which he prophesied the trend of future electrical development. In the electrical age to which he looked forward all the world's drudgery would be done by automatic machines—'robots' driven electrically and controlled by human minds. The enormous saving in labour and waste would be a priceless boon to humanity. Assuming that everything were done as he suggested, he calculated that the average cost of an electric unit would be reduced to $\frac{1}{8}$th of a penny. He assumed that the nitrogen in the fuel would be recovered in the form of ammonium sulphate, which could be used for the intensive cultivation of home-grown food. Coal could be conserved, and as there would be less smoke there would be more sunshine. It was a remarkable address delivered in a most pleasing and attractive way, as if it had been composed with little or no labour. He told me, however, that he had spent laborious months composing it and checking the necessary calculations.

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Ferranti married the second daughter of Mr. Francis Ince, a solicitor who gave a great impetus to the electrical industry in its early days. One of Ferranti's sons, Basil, was killed in the War, after distinguishing himself as a major and gaining the military cross; another son, Vincent, is a director of Ferranti's. Ferranti's home at The Hall, Baslow, Derbyshire, was fitted up with every electrical convenience, including even artificial sunshine. His seaside house in Wales was also 'all-electric'.

He was a great motorist, and for his summer holiday he often went for a motoring tour abroad. In the winter he and some of his family went to Switzerland for the winter sports. On Dec. 19 last he attended the meeting of the Institution of Electrical Engineers, at which Mr. Haldane read a paper on a heat pump which reversed the Carnot cycle of operations. Ferranti was enthusiastic over it, and reminded me that Prof. Perry as well as Kelvin had advocated reversing the Carnot cycle. He was just starting for his winter holiday, and was looking forward to skating and to seeing his children and grandchildren taking part in more active sports. His death at Zurich on Jan. 13, following an operation, came as a great shock to his many friends all over the world.

Ferranti, through his father-in-law Mr. Ince, was closely connected with Faraday House Electrical Engineering College. At the old students' dinner on Oct. 25, in proposing the toast of the College, he encouraged the students by reminding them of his own strenuous struggle during the days of his youth. He missed in his student days, by a hairbreadth, the invention of the tungsten filament lamp and the induction motor. He attributed these failures to lack of technical knowledge, and urged the students to use every endeavour to widen their knowledge. One could never tell what scientific fact would give the key to an invention.

Ferranti was a great inventor and engineer, one of the greatest the world has ever seen. We need merely mention the mercury meter, the Ferranti alternator, the Ferranti rectifier, the Ferranti concentric cable, Ferranti switchgear, the Ferranti steam engine, the Ferranti steam valve, his system of earthing, his induction furnace, his high temperature improvements of the steam turbine, his systems of electric welding, and his high-speed spinning machinery for cotton mills. There are many more. Electricity supply as we know it to-day was largely fashioned by him. In England, in America, and practically all over the world, his name is a household word in engineering circles. Yet he was a singularly modest and retiring man. He never stood in the limelight or pushed himself forward for public recognition. Foreigners after meeting him sometimes asked, wonderingly, "Was that the great Ferranti?"

He was a fellow of the Royal Society, an honorary member and Faraday medallist of the Institution of Electrical Engineers, an honorary member of the American Institute of Electrical Engineers, and an honorary D.Sc. of the University of Manchester.

A. RUSSELL.

PROF. H. L. CALLENDAR, C.B.E., F.R.S.

IT is with deepest regret that we record the death of Hugh Longbourne Callendar, professor of physics at the Imperial College of Science and Technology. He was born in 1863, and died after a brief illness on Jan. 21 last. He leaves a widow and three sons.

Callendar received his early education at Marlborough at a time when little encouragement was given to a brilliant scholar to take up any form of experimental science, and he passed through the school on the classical side. In his first year at Trinity College, Cambridge, he received college prizes for classics and mathematics, obtained a first class in Part I. of the Classical Tripos of 1884, and was bracketed sixteenth Wrangler in the Mathematical Tripos of 1885. Afterwards, however, his whole career was devoted to the experimental branches of physical science, in which he developed a degree of skill and a *flair* for accurate work that left him without a rival.

Callendar's first work, on the platinum resistance thermometer, was communicated to the Royal Society in 1886, during which year he became a fellow of Trinity College, and his researches on temperature measurement were continued at the Cavendish Laboratory until 1893. After a brief interlude at the Royal Holloway College, Egham, he accepted appointment to a professorship of physics at McGill University, Montreal, remaining there for five years. During this period he developed his method of continuous electrical calorimetry, the first application being the measurements by his assistant Barnes on the specific heat of water. It was also at McGill that he first brought his knowledge to bear directly on the problems of engineering science, and in conjunction with Nicolson he made many valuable discoveries on the heat transmission and leakage losses from steam engine cylinders.

In 1898, Callendar returned to England as Quain professor of physics at University College, London, and in 1900 he first put forward his characteristic equation for an imperfect gas which has been so useful and satisfactory in representing the properties of steam. He accepted appointment as professor of physics at the Royal College of Science, now incorporated in the Imperial College of Science and Technology, in 1902, and still filled the chair at the time of his death. His long occupancy of this post has been crowded with work representing not only the developments of his early researches but also brilliant and vital investigations on many new lines to which he turned his attention.

Of the many services which Callendar has rendered to pure and applied science, it is difficult to say which should be placed first, but undoubtedly the most widespread utilisation of his researches lies in the applications of the platinum resistance thermometer. In this instrument, Callendar not only gave to the research worker a method of the highest order of accuracy for the measurement of temperature, but also gave to the engineer and metallurgist a convenient and

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