of London prevented spoliation and wholesale destruction, so that the Charity as it exists to-day still retains some of its original archaic characteristics. A succession of great surgeons—Vicary, Gale, Clowes, and Woodall—held office in the hospital under the later Tudor sovereigns. They were men who had gained their experience in the foreign wars and had served so far afield as Poland and Russia. Rough, practical surgeons, they concerned themselves with the sick and hurt and in an abortive attempt to raise their own professional status. Of science they knew nothing. It was slightly better, perhaps, on the medical side. Dr. Timothy Bright did some service when he invented his system of shorthand, but the discoveries of William Gilbert in magnetism seem to have been entirely unknown to them, although as members of the same profession and of the same college, living together in a small town, they must have been constantly in association with him. The governors of the hospital would indeed have done themselves great honour had they chosen him as their first physician under the new foundation instead of electing one who was afterwards hanged, drawn, and quartered for conspiring to poison Elizabeth.

The real scientific history of the hospital begins with William Harvey, appointed physician in 1609, who announced his discovery of the circulation of the blood in the Lumleian lectures at the College of Physicians in 1616. The discovery revolutionised the practice of medicine and made possible an experimental physiology. The very simplicity of the proofs were a stumbling-block to his contemporaries, but the teaching was eagerly accepted by the younger generation, those founders of the Royal Society who formed so wonderful a band at Oxford and in London just after the Restoration.

When Harvey died, the mantle of science in the hospital fell sometimes on the medical and sometimes on the surgical side of the house. Percivall Pott began to teach surgery systematically, and his lectures were

attended by John Hunter, the founder of scientific surgery in England. The pupils of Pott followed each other in a long succession as surgeons to the hospital and *quasi cursores* handed on the Hunterian teaching to our own day. Earle and Abernethy, Lawrence, Savory, and Butlin bridged the interval between the death of Hunter and the dawn of Lister. But, as in the time of Harvey, the older teaching had become so ingrained in the school that it was found difficult to accept the doctrine of the germ theory of disease and the revelations of antiseptic surgery. It was not until a new generation came into its own that men like C. B. Lockwood entered whole-heartedly into the promised land of Listerism, and Klein, Kanthack, and Andrewes advanced the great science of bacteriology.

Until 1836 the teaching of chemistry was in the hands of the physicians to the hospital, but from that time onwards it became specialised and the school was fortunate in obtaining a regular succession of first-rate teachers; Brand, Stenhouse, Frankland, Abel, Odling, Russell, and Chattaway followed each other, the students were well taught, and some opportunities were afforded for original work. In like manner, Sir Lauder Brunton, before he became physician to the hospital, was a pioneer in experimental pharmacology, and in that branch of knowledge which has since developed into bio-chemistry. Between 1882 and 1912 Steavenson and Lewis Jones by their work at the hospital raised medical electricity from a scientific empiricism to its position as a recognised branch of medicine. Lewis Jones, indeed, in his all too short life fairly earned the title of "the Father of Medical Electricity."

A great hospital leads to advances in many departments of science. New problems are constantly presented; the permutations and combinations arising in the complex structure of the human body are endless and the chemist and physicist are often able to give material help in placing medicine upon a firm basis of fact.

The Complete Gasification of Coal.

By Dr. J. S. G. THOMAS.

IT is well known that the percentage thermal efficiency of gas production from coal can be increased by gasifying the coke resulting from the high temperature carbonising process, and various processes and plants for effecting this conversion have long been available. Shortage of fuel supplies during the years of the War, and afterwards, resulted in the Board of Trade issuing instructions to gas companies to "stretch" their supplies of gas. The "stretching" process intended was to consist of a reduction of calorific power of the gas supply, accomplished by dilution of straight coal gas with either blue or carburetted water gas. The attention of the industry in all countries was, at the time, naturally directed towards increasing the efficiency of production of water gas and its efficient utilisation admixed with coal gas in a towns' gas supply. In England considerable work on these lines was done by George Helps, the "big noise" of Nuneaton.

Much publicity has recently been given to a plant designed by C. B. Tully, and operated at Bedford, for the complete gasification of coal. Altogether, since

1919, about two hundred such plants have been erected in this country, the largest being installed at Halifax, which is capable of producing about 7000 therms per day. The installation at Bedford comprises two sets, each capable of producing about 2500 therms per twenty-four hours. The average percentage composition of the gas is approximately CO_2 , 5; N_2 , 5; O_2 , 0.5; CO , 36; H_2 , 45; CH_4 , 8; C_nH_m , 0.5, and the calorific power is about 350 B.Th.U. per cubic foot. Bedford is supplied with a mixture of straight coal gas with about 51 per cent. of this gas, the resulting calorific power being about 460 B.Th.U. per cubic foot. Manufacturing costs in the case of the Tully plant are stated to amount to about 2.74d. per therm and the capital manufacturing charges to about 0.08d. per therm. The desirability or otherwise of the manufacture and distribution of this gas in any definite case must be determined by a variety of factors, among others by the size of the undertaking, local conditions as regards supplies of raw coal, characteristics of the demand for gas, storage capacity, and size of the distributing

system. Increased costs must be incurred in the distribution of the gas compared with those incurred in the case of straight coal gas.

On one matter to which public attention has recently been directed we would remark that the possibility of converting the comparatively large percentage of carbon monoxide in water gas into carbon dioxide or methane is by no means a novel proposition either from the scientific or industrial point of view. Sabatier and his co-workers showed, many years ago, that in the presence of nickel, cobalt, or palladium, carbon monoxide and hydrogen at 230-400° C. react to form methane and water, thus: $\text{CO} + 3\text{H}_2 = \text{CH}_4 + \text{H}_2\text{O}$. This hydrogenation is subject to the important objection from the technical point of view that while hydrogen must be present in excess, an equal volume of hydrogen must be added to water gas to provide the mixture theoretically necessary. This hydrogen can be derived from water gas, and the net result is that the yield of methane is only about 15 per cent. of the total water gas employed. Sabatier pointed out that by passing water gas over nickel at 400-500° C. the following reaction occurred: $3\text{CO} + 3\text{H}_2 = \text{CH}_4 + \text{H}_2\text{O} + \text{C} + \text{CO}_2$. The carbon deposited on the catalyst may, at the same temperature, be caused to react with steam to form a mixture of hydrogen, methane, and carbon dioxide, whereby the catalyst is regenerated for use in the first phase of the process. Sabatier further suggested that both phases might be combined by passing water-gas and steam over a nickel catalyst at 400-500° C., when the following reaction occurs: $5\text{CO} + 5\text{H}_2 + \text{H}_2\text{O} = 2\text{CH}_4 + 2\text{H}_2 + 3\text{CO}_2$.

These various reactions are summarised in a recent paper by Drs. E. F. Armstrong and T. P. Hilditch, read before the Royal Society (see *NATURE*, February 3, p. 168), in which they direct attention to a reaction between carbon monoxide and hydrogen which has hitherto apparently escaped notice. They find that

the action between equal volumes of carbon monoxide and hydrogen in the presence of nickel or a similar catalyst at temperatures below 300° is in the main represented by $2\text{CO} + 2\text{H}_2 = \text{CO}_2 + \text{CH}_4$. It will be noticed that the gases carbon monoxide and hydrogen participate in the reaction very approximately in the relative proportions in which they are present in blue water gas, (43 per cent. CO , 48 per cent. H_2). The reaction, though never complete, proceeds to a very considerable extent, and the authors consider the process may be of value in gas practice as the proportion of methane is 25 per cent. of the water gas decomposed, whereas by any of the other processes referred to the maximum possible yield is only 20 per cent.

The idea of the technical utilisation of the first reaction referred to above for the production of methane, and the application of the reversible reaction $\text{CO} + \text{H}_2\text{O} = \text{CO}_2 + \text{H}_2$ for the production of hydrogen has recently been revived in connexion with the Tully plants. It must be realised that little if any actual large-scale operations of this nature have hitherto been carried out. Considerable experience is necessary for the successful operation of catalytic plants operated at relatively high temperatures and dealing with the huge volume constituting a day's make of towns' gas in the case of even one of the smaller gas companies. It is contemplated that the plant required would be of the same nature as that designed for the catalytic purification of gas from sulphur compounds which is in successful operation in the works of the South Metropolitan Gas Company. Operating charges would possibly amount to about $\frac{1}{4}$ d. per therm. It is questionable whether it would be technically feasible to remove the carbon dioxide produced. A suitable catalyst has been prepared, and small-scale operations in a plant capable of treating 200 cubic feet of gas per hour have been carried out. Large-scale operations constitute a much more difficult proposition.

Obituary.

MR. F. W. HARMER.

BY the death on April 24 of Mr. Frederic William Harmer, within a few days of the completion of his eighty-eighth year, the county of Norfolk loses one of its most distinguished sons and East Anglia the penultimate survivor of a band of amateur and professional geologists to whom science is under deep obligations, not merely for the elucidation of local problems, but for the establishment of principles and of methods of research of European or even wider application.

Mr. Harmer, descended from a stock the most ancient in Norfolk, was early imbued with a love of science, especially of geology, and the fortunate chance of a meeting in 1864 with Searles V. Wood the younger directed his enthusiasm and energy along lines of research that, with one significant break, he followed to the end of his long and useful life. The two friends embarked upon the study of the records of the Ice Age, and, in pursuance of Wood's conviction that accurate mapping of the glacial deposits was essential to the decipherment of their story, the task—never before attempted—was undertaken, and in the course of a few years an area of 2000 square miles was mapped on

the scale of one inch to the mile. Harmer's share was the county of Norfolk and the northern parts of Suffolk.

Wood told the present writer that the young officers of the Geological Survey with whom he was often in conflict ought to be grateful to him and his friend because their demonstration of the practicability of mapping drift deposits had compelled the Survey to increase its staff. Copies of the map, claimed by its authors to be the first of its kind ever produced, have been deposited in the library of the Geological Society and in the Museums at Norwich and Ipswich, and a lithographed reduction of the eastern portion was appended by Wood to one of the supplements to his father's great monograph of the Crag Mollusca.

The period of his association with Wood, of whom Mr. Harmer always spoke with touching reverence and affection, was brought to a premature close by the complete breakdown of Wood's health ending with his death in the early 'eighties. The loss of his friend and master acted as an effective damper upon Mr. Harmer's geological activities, and for more than a decade he threw his energies into business and the multifarious duties of municipal life.