

Mr. Marconi calculates that the speed of signalling with a 100-metre wave, having a frequency of three million, will probably be a hundred times as great as that obtained with a frequency of 30,000, which is of the order of those that it is proposed to use for the Imperial Stations.

Further tests in June last were made between Poldhu and a small receiving station at Buenos Aires in the Argentine (5820 miles). A parabolic reflector was employed to concentrate the energy stream towards the Argentine. Although the power radiated was only 17 kw., strong signals were

received for more than ten hours a day at Buenos Aires.

Mr. Marconi is strongly of opinion that by means of these small and inexpensive stations a far greater number of words could be transmitted between England, India, and distant British Dominions than would be possible by means of the previously planned powerful and expensive stations. The communications also would be much more secret than that obtainable by any of the present systems. In conclusion, he expresses his high appreciation of the excellent work done by Mr. C. S. Franklin in this connexion.

Obituary.

SIR GEORGE BEILBY, F.R.S.

SIR GEORGE BEILBY died on July 31, in his seventy-fourth year, and when he had just laid aside the harness by which he had so long applied his talents with great effect in varied fields. His death caused widespread regret and directed attention to a notable record of public service in the linked relations of science, industries and citizenship. Fortunately for industry his early work brought him into close touch with the details of production as well as with scientific problems which confronted the chemical manufacturer. His skill and thoroughness in investigation, and his clear appreciation of the conditions of large scale work, enabled him to make successive additions of much value to the methods of industry. His relations with commercial production became such that he was in a position to follow up his researches in science by investigation of those of their applications which seemed to be promising. The success which from time to time attended his steady and enthusiastic labour enabled him to give to public purposes much of his energy, as well as to afford substantial support towards the advancement of science and the training of promising recruits for the ranks of scientific workers. Withal, the man and his life will remain in the minds and hearts of many, young and old, as a beacon no less bright than his work.

The son of Dr. G. T. Beilby, a well-known medical practitioner in Edinburgh, Sir George was born there in 1850. He was educated in Edinburgh schools and the University, and he joined the staff of the Oakbank Oil Company as a chemist in 1870. This appointment marked the opening of his professional work, which falls into three periods commencing in 1870, 1890, and 1914 respectively.

1870-1890.—A few years after joining the staff at Oakbank, Beilby became manager, and he held this position until about 1890; thus from 1870 to 1890 his work centred on the Scottish oil industry. He introduced improvements in several sections of the work, the most important being the use of large volumes of superheated steam which was passed into and through the spent shale in the retort, converting the carbon of the shale into water-gas and the nitrogen largely into ammonia. This procedure had several notable advantages, of which the main one was that it more than doubled the yield of ammonia—a result which saved the Scottish oil industry from extinction during the years of severe competition by petroleum.

The minor advantages of the process were: (1) the

water gas, formed and heated in the lower part of the retort, conveyed heat internally to the shale in the upper portion, thus assisting to distil the shale at moderate heat; and (2) the removal of carbon from the spent-shale was practically complete, so that fires in the spent-shale “binges” which made these a nuisance in their neighbourhood were avoided. Beilby erected his original retort, operated on these lines, at Oakbank, but later he associated himself with the late Mr. James Young, who was experimenting on similar lines, and together they brought out the “Young and Beilby” retort (patented 1881), which is the prototype of the existing forms.

It is of interest to note that the use of steam in gas production with the purpose of recovering the nitrogen of the coal as ammonia was first proposed by Beilby, who practised it on an industrial scale at Oakbank Oilworks.

Towards the close of the first period of his work Beilby's attention had been attracted by the advent of the McArthur Forrest patents (1887) for the extraction of gold from its ore by means of cyanides. The probable demand for cyanides appeared to him to open an extensive field for chemical industry, and he proceeded to investigate the possibilities of preparing cyanide cheaply. This led shortly to his putting down a small factory near Edinburgh, where he produced the material in fair quantities at a price much lower than that reached by other makers.

1890-1914.—Beilby laid his cyanide process and its results before the directors of the Cassel Gold Extracting Co. of Glasgow (now the Cassel Cyanide Co., Glasgow). His process was accepted, and he became a director and partner in the firm. The process was used exclusively and profitably by this Company until 1900, when Castner introduced a new process for cyanide manufacture, on the development of which Beilby and Castner worked together. The improved process which they worked out was adopted by the Cassel Cyanide Company. At this time Beilby joined the board of directors of the Castner Kellner Alkali Co., Glasgow, and until the outbreak of war he took a leading part in the development of the two companies mentioned.

While this period consolidated Beilby's position as one of the pioneers and leaders of recent progress in chemical industries, it also brought to the front a parallel line of his activities in research—the *using of fuel*—and in this connexion it led to a steady increase

in the proportion of his time devoted to public work. Concurrently with his early work in the development of the recovery of ammonia from shale at relatively low temperatures, he had conducted experiments in steaming bituminous coal. From this onwards he never lost touch with the national problems of prevention of smoke and the economical use of coal. His work on fuel came prominently before the public when he took part in the inquiry of the Royal Commission on Coal Supplies in 1903. He then submitted an analysis of the purposes to which the British output of coal is applied and an estimate of the scope for economy attainable in each category of use by improved methods. His subsequent investigations were at first (1906-1912) directed to the production of a smokeless fuel for domestic purposes. The record of that work, communicated at the 1913 meeting of the British Association, showed that in treating comparatively non-caking coals satisfactory economic results could be obtained. The experiment was, however, discontinued, for the inquiries of the Royal Commission on Fuel and Engines for the Navy, 1912-13, gave a new and wider significance to low-temperature carbonisation. Lord Fisher was chairman of the Commission, and Beilby, as one of its members, could bring to the table not only full knowledge of ascertained fact, effective processes and attained results, but also a ready appreciation of the broad considerations specially relevant to the issues before the Commission. The Commission reported that the only means of rendering Great Britain to some extent self-supporting in the matter of fuel-oils lay in the development of a new carbonising industry founded on the distillation of coal at a temperature much below that used in gas-retorts or coke ovens.

1914-1923.—It was to the problem thus set to British science and British industry that Beilby gave of his best in the last ten years of his life. During the earlier War years his work and his thoughts were much diverted to other issues; but the fuel question was never far off.

When Lord Balfour, then First Lord of the Admiralty, formed the Board of Invention and Research with Lord Fisher as chairman, Beilby was naturally appointed to the Board. It is understood that in much of the great work with which that Board had to deal he proved most fertile in suggestion and wise in consultation and advice. On this section of his public service it may be recalled that in the King's birthday honours list for 1916 he was included among the new knights, being described as "a well-known chemist and inventor, who has specially studied fuel economy, and has rendered service to the Admiralty as a member of the Central Committee of the Board of Invention and Research, and in other ways."

In 1915, when it had been decided to reply in kind to the gas attacks first made by the enemy on the Ypres sector on April 22, 1915, Beilby was sent for by Lord Kitchener, at whose request he arranged that the Castner Kellner Company should provide a supply of liquid chlorine in cylinders. He became a member of the War Office Committee then formed to devise and test materials for offensive chemical warfare. On the formation of the Ministry of Munitions this matter was transferred to the new Ministry.

Throughout these years Beilby gave his whole time to work for the Government, mainly in the Trench Warfare Department and its successor, in 1917, the Chemical Warfare Department. Needless to say, the work of the various advisory and supervisory War Research Committees was most strenuous and exacting. Beilby was indefatigable and resourceful always. He was much more. His calm, careful and sympathetic consideration of every intelligent suggestion or criticism were of great value in securing for the service the best use of the talents of the willing and able workers in the field. His individual contributions to scientific investigation of problems arising on appliances for attack or defence were always clear and definite; his guidance on points affecting design with the view of mass production or on suggestions for expediting manufacture was thoroughly practical. The anxieties of the time were many and often sudden. On such occasions Beilby was a great asset. His quiet manner, his refusal to be fussed, the personal sacrifices he made as a matter of course, and his consideration for all who worked with or under him, were of the highest value in the improvised organisations of the time.

But already in 1915 the Government had taken a first step to prepare for attacking the problems which would have to be faced on the advent of peace. A Committee of Council for Scientific and Industrial Research had been constituted, and in 1916 the Department of Scientific and Industrial Research was established, with a strong advisory council of men of science as the central feature in its organisation. Of this council Sir George Beilby was one of the original members. In its first year the council, recognising that fuel was at the root of British industry, advised that the Department should tackle the fuel problem. A year later, despite his other national work, Beilby was prevailed upon to accept the invitation to direct fuel research for the Department, put to him first by Lord Crewe, when Lord President of Council, and again by Lord Curzon when he succeeded to that office. The Fuel Research Board was set up in 1917 with Beilby as its chairman and as Director of Fuel Research.

The burden which Beilby thus took up was a heavy one, and at the initiation of the work he was closely engaged in the war activities indicated above. Moreover, the past strain had pressed him not a little and he had had to undergo an operation for appendicitis. While still feeling the effects of that, he had returned to his war work with his customary energy; indeed his spirit appeared to have carried him through without lasting effects.

The design, construction and equipment of the fine Fuel Research Station at East Greenwich were carried through under Beilby's personal supervision, so that the station, its possibilities, its organisation and its staff represent his conception of what is required as the centre of national investigation and research as to fuel production and the using of fuel. The development of the relation of the Fuel Research Board and of its central station to investigations carried out in coalfields and other laboratories had necessarily to wait for more normal conditions, but this, too, had been arranged and initiated before he regarded the organisation as being on a basis so secure that he was justified in demitting the office of Director of Fuel Research.

By the end of 1917, the first year of the work of the Station, the problem set by the Fisher Commission of 1913 had been solved in its scientific and technical aspects sufficiently to permit home production of fuel-oil under war-conditions if need had continued to press. Commercially it still stands a problem. The normal work of the Fuel Research Board has been noted from time to time in these columns. It therefore suffices here to say that the whole organisation is to all intents and purposes Sir George Beilby's creation. That early result of reference to the Board—the establishment of the method of charging for town gas by the "therm"—is now recognised as one of those little things which exercise prevailing influence to the advantage of producers and consumers alike.

Sir George Beilby was never without a side interest or hobby with a scientific bearing. He took a keen interest in colour photography and in microscopy. In the former he made himself expert in the use of the Lumiere process in photographing mountain scenery in Switzerland and the Tyrol, and he applied it also in photomicrography. Indeed, some of his photomicrographs, prepared in 1913, were reproduced in a colour-plate published in *NATURE* of February 19, 1914. Microscopy, from being a hobby, became, and continued, for him a serious study. It was the only method of investigation which he could follow with satisfaction intermittently in casual short intervals in the busy daily life of a busy man. Faced, as a cyanide manufacturer, with the difficulty of finding any metal tube which would withstand the action of ammonia at 700° C. for any length of time, he turned to the microscope for suggestions as to the conditions of the problem.

From this Beilby was led to investigate the effects of various forms of mechanical work on the crystalline structure of metals, for example, the disturbances which occur in the processes of polishing and burnishing. As usual he spared no pains in making himself a master of the technique of the methods which he employed to study his subject from every angle. He made an experimental study of a number of solids in various states of aggregation. His researches in this field, which were ingeniously planned and most accurately carried out, were of an entirely novel kind. He gave an account of this work in the May lecture which he delivered to the Institute of Metals in 1911. In his book, "The Aggregation and Flow of Solids," 1921, he published collected statements of his work on this subject, including his more recent investigations. The facts he recorded are those which he established by most careful work and observation repeated time and again. These and the theory of the hard and soft states of metals which he put forward in 1911 had a profound influence for several years on the development of metallography, and gave rise to a variety of researches designed to test the range of application of his theory. In view of recent researches on the constitution of matter it is difficult to judge the precise form of the theory which will ultimately be accepted, but there can be no two opinions as to the magnitude of the service he rendered to the elucidation of the changes produced in metal crystals by mechanical work of all kinds.

As a citizen—indeed in all relations—Beilby sys-

tematically shunned publicity. Even in matters of public interest for which he did active work, his help was so unobtrusive that it was little known unless circumstances made his emergence unavoidable. Education, training for and in research, smoke prevention, each succeeded in identifying him, but these were by no means the limits of his active help in affairs. In 1877 Sir George married Emma, daughter of the Rev. S. Newnham, and Lady Beilby has been a devoted coadjutor in many of his public interests. With her he was early among those who worked for the admission of women to professions, and this cause appealed to him in the first instance in the critical case of medicine. Their interest in students, particularly students of science, began many years ago, and only few have even a general idea of the extent to which he coupled financial help with advice as to courses of training or subsequent experience. Sir George was one of the trustees of the Carnegie Trust for the Universities of Scotland, and he took a keen interest in the details of the work of that Trust. He was a fellow of the Royal Society, and one of the first members of the executive of the National Physical Laboratory formed by the Society in 1900 with Lord Rayleigh as chairman.

It was, however, the Glasgow and West of Scotland Technical College—now the Royal Technical College—which indented most fully on his ready help in council. He was co-opted as a governor of the college in 1900, and on the Board of Governors his wide knowledge of men of science and of industry soon commanded the confidence of his fellow-governors, and his foresight did much to secure that the building then being planned was conceived on an adequate scale. In 1903 he became convener of the sectional committee on the departments of chemistry, technical chemistry and metallurgy. The scheme of teaching and the nature of the laboratory courses and appliances adopted were novel at the time, but have since proved applicable in other places. In 1907, on the death of Sir William Copland just when he had completed the task of raising funds for the erection of the new buildings for the college, Sir George Beilby was elected chairman of the governing body.

The new buildings and equipment secure, the governors and staff strove strenuously, and with success, to raise the standard reached in the college teaching and to develop the training of promising students in methods of research bearing on industries. In 1913 the college was affiliated with the University of Glasgow and was included among the institutions recognised for grants by the University Grants Committee. The raising of the college ideals and the effective efforts towards improvement of practice were largely due to the all-prevailing influence and wise initiative of the chairman. His fine personality was a great asset in every development of the college and its work.

One example of this may now be mentioned. Sir George had been providing funds year after year to enable good men to remain at college for training in research methods for a year or more after completing their ordinary courses. When the results of this encouragement had become amply apparent he set about placing this help and cognate facilities on a

permanent footing. A "New Development Fund" was established and started by an anonymous contribution of 10,000*l.* Sir George was the donor. He was one of those who knew how to use money to good purpose. The fund was well opened, and although the war years checked its growth it now amounts to 65,000*l.*

Sir George Beilby's fine personality was a great asset in every development of the Royal Technical College and of its work. His touch with students was, however, of long standing and it was real, informal and elevating. His house in Glasgow was for years a place of resort for young men. Music had a home there—Sir George himself was an artist in music; he was also a first-class craftsman; he built his own organ, buying only the pipes, and much of the refine-

ment of its mechanism was of his own invention. Conversation there on current topics never flagged in interest although it often strayed. Personal talk or counsel on individual aims or on difficulties over study always refreshed the visitor.

In our world of to-day—its science, its industries and its humanities—Sir George Beilby has been a notable exemplar of the "veray parfit gentil knight."

WE regret to announce the following deaths:

Sir William Bayliss, F.R.S., professor of general physiology in University College, London, on August 27, aged sixty-four.

Dr. John J. Stevenson, professor emeritus of geology at New York University and president in 1899 of the Geological Society of America, on August 10, aged eighty-two.

Current Topics and Events.

THE recent conference at Oxford on "The Scientific Approach to Religion" was a notable event and aroused a good deal of interest in the Press and the public. The change of tone is amazing since the famous Diocesan Conference at Oxford in 1864, when Disraeli strolled in and declared himself on the side of the angels and not of Darwin. Of course the battle had been won long before this, but it was well that Oxford should be the scene of so striking a reconciliation after the half-century. The notes struck were, the abandonment of final and exclusive dogmas either on the side of science or of religion, and the possibility of a man of science being a theist and Christian, and of the "religious" person accepting all or any of the established conclusions of science. We imagine that nowadays few people will be found to dispute any of these propositions. We all agree in general terms; the difficulties arise when we come to define them. This could be illustrated from almost any of the papers read. For example, Dr. Rollin stated that the point of the theists had been demonstrated that the world in its essence was a form of energy, and energy, so far as all our knowledge went, did not come from nowhere. But would such a doctrine satisfy any theist who thought out carefully what he meant, or would it have convinced Ostwald that he was a theist? The fact is that such an eirenicon as was proclaimed last week in Oxford is rather testimony of general goodwill, of a change of temper, and of a readiness to examine, than of definite agreement as to really disputable points. For what it was, we heartily welcome it and would not add a word to hinder so healthy a process. We need above all to strengthen the bases of our intellectual and social amity, but let us make sure of the strength of the stones we lay. It would be a disaster if they crumbled into sand when we began to raise the superstructure.

At a recent meeting of the Wiltshire Archæological Society a discussion took place with reference to permission having been granted to a modern sect styling themselves "Druids" or "Church of the Universal Bond," who contemplate burying the ashes of their dead within the precincts of Stonehenge. The discussion was followed by a strong protest

against this unseemly intrusion. It is only a few years since this well-known monument was handed over to the nation by a generous donor, and as it came thereby under the protection of H.M. Office of Works, it was hoped that this would effectually stop desecration and any future trouble. A question in the House of Commons regarding a rumour of the proposed burial of ashes, put by the member for the Salisbury Division to the First Commissioner of Works, elicited the reply that permission had actually been given. Apparently the Commissioner had been approached by the sect privately and gave the desired permission on his own initiative without consulting the Advisory Board or taking thought what the result might be. This deplorable attempt at vandalism is strongly resented in the County and by the public generally, who hold in reverence the mighty monument set up by our progenitors. The members of the "Church of the Universal Bond" have camped for a fortnight annually upon the downland about half a mile from Stonehenge, and the Office of Works, despite suffering irritation from them, generously gave permission for services to be held within Stonehenge. Instead of being grateful for this boon an insulting letter was sent in reply, asserting that the place belonged to the sect, and no advantage was taken of the concession. Apparently an attempt is now being made to secure a hold upon the place, and this move should be resisted vigorously and to the utmost by every one who has a regard for Stonehenge. It is ridiculous to think of a small and obscure set of people having the impertinence to arrogate a claim to this National Monument. With just as much reason another sect might arise calling themselves "Romans" and laying claim to Roman villas.

SPAIN is a country rich in archæological remains, and many are the investigators who have made notable discoveries there. English readers have been hearing from time to time about the work of Mrs. Wishaw and the founding of the Anglo-Spanish School of Archæology at Niebla, Huelva, in Andalusia. A long article on her discoveries appeared in the *Times* of August 23, and we have received the following note upon it from a contributor, M. C. B.:—Mrs. Wishaw's