

## OBITUARY NOTICES.

### JOHN PERCY BATEY.

BORN MARCH 22ND, 1889; KILLED IN ACTION APRIL 9TH, 1918.

JOHN PERCY BATEY, M.Sc.(Tech.), was educated at the Manchester Municipal Secondary School, where he was awarded a three years' scholarship to the Manchester School of Technology. He took the degree of B.Sc.(Tech.) in 1908 when nineteen years of age, and was also awarded the Schuster Research Scholarship. Twelve months later he was made M.Sc.(Tech.). For a time he was lecturer and demonstrator, and in 1911 he became assistant to Dr. Liebmann, of Weybridge, where he remained until he enlisted in January, 1915.

He joined the Public Schools Battalion, the Middlesex Regiment, transferring later to the Royal Engineers, and went to France in August, 1915. He was promoted to the rank of Company Sergt.-Major in September, 1916. In 1917 he was awarded the Belgian Croix de Guerre, and in 1918 the D.C.M.

With regard to the D.C.M. the *Gazette* published the following:

“He volunteered on no less than eleven times in one month to conduct parties carrying rations and supplies over a very much exposed area that was being heavily shelled by the enemy to gun emplacements in the front line. The fine example of courage and devotion to duty of this warrant officer had an excellent effect on the N.C.O.'s and men of his company.”

F. B.

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### LIEUT. CHARLES WILLIAM DICK.

BORN APRIL 10TH, 1895; DIED ON SERVICE NOVEMBER 9TH, 1918.

LIEUT. CHARLES WILLIAM DICK, R.A.F., died of pneumonia on November 9th last in Cliff Military Hospital, Felixstowe. Mr. Dick, who was the younger son of the late Mr. J. Dick, schoolmaster, North Shields, took 1st Class Honours in his Inter B.Sc.(London) on leaving Rutherford College, Newcastle-on-Tyne, in June, 1912,

and in the autumn of the same year gained an open science scholarship at Cambridge University and became a scholar of Trinity Hall in the autumn of 1913. He passed his final for the B.Sc.(Lond.) in 1914, and on completing two years' residence he postponed further study to become a chemist at Messrs. Curtiss' and Harvey's explosives works at Cliffe, near Chatham, and whilst there was elected a Fellow in 1917. He joined the Meteorological Section of the R.N.V.R. in April, 1918, and after completing his training was appointed meteorological officer at Felixstowe Air Station, and on the creation of the R.A.F. was transferred to its establishment in August, 1918.

J. E. D.

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JAMES HECTOR BARNES, D.Sc.

BORN 1879; DIED 1917.

"I AM sorry to say I have been in very poor health all the summer and had to take six weeks' leave in Kashmir this autumn; it was no holiday, however, for I spent four weeks of it in bed with an irregular pulse—the old story of India, malaria, and, the doctors say, overwork. I hope to come home next summer, for I do not think I can stand another Indian summer here without first having a rest in a decent climate. I shall look you up then, and I hope you will be kind and put me in the way of being useful while at home on leave as I really cannot idle about."

These extracts are from a letter dated November 30th, 1916, received from Hector Barnes. He did not come home, and his prophecy was fulfilled; he did not stand another Indian summer, but at the age of thirty-eight, in the fullness of his intellectual powers, with high hopes and with great opportunities opening before him, he died in India. It is difficult indeed to write any adequate record of the worth and work of such a man. The scientific work which he accomplished, had it been carried out in the most favourable environment, was such as any chemist might be proud to have to his name. But it was carried out under conditions which would only be met by a man of heroic temperament. Such a man Barnes in truth was.

In the plains of Northern India, at Lyallpur, a remote station, on land recently transformed from a sterile desert into a luxuriant agricultural colony by the marvellous system of Indian irrigation, Barnes betook himself in 1906. Born in 1879, he had received his scientific training at the University of Birmingham, where he

studied chemistry and physics under Professors Frankland and Poynting and graduated B.Sc. He had previously been apprenticed to Messrs. Southall and Barclay, pharmaceutical chemists, and the experience of the practical conditions of manufacturing operations which he there acquired no doubt added greatly to his equipment for the work that was in store for him. At Lyallpur he held the position of agricultural chemist to the Punjab Government and professor of chemistry in the Agricultural College, then at the stage of inception. He threw himself wholeheartedly into the work of designing the chemical laboratories, and in 1908 his responsibilities were increased by his appointment as Principal of the College. A year later the College was open for the reception of students. There was an immediate response, as there is to every new educational enterprise in India; but when it was found that the College was not, as it was expected to be, a certain path to Government service, the numbers fell with great rapidity and any belief that there was widespread zeal among neighbouring landowners for agricultural science could not be sustained. Barnes, however, had cherished no illusions, and he knew from the first that the foundation on which he must build was sound scientific research addressed as directly as possible to vital questions of Indian agriculture, and to this he and his colleagues bent their energies. It is not easy to give an idea of what that meant. The physical obstacles imposed by the climate and ever-recurrent sickness, the isolation from the scientific world and from the meagre supplies of apparatus anywhere available in India—these alone might daunt a strong man. Add thereto, only in a more intense form, what we have in England—Government officials in authority whose "humanisation" has precluded the slightest knowledge of what science is, what it does, and how it can be applied to do more—and it may be understood that it is only the very exceptional man who can succeed. This Barnes did in the most conspicuous degree. Standing in the laboratories at Lyallpur after some hours' journey from Lahore through great tracts of solitude and finding apparently all the resources of a European university science department and men busily engaged in employing the experimental methods of modern physical chemistry in the elucidation of fundamental problems in agriculture, the greatness of the achievement was very striking to the imagination. Within a stone's throw were the mud walls of an Indian village with its population living unchanged in the beliefs, the thoughts, the habits of life and work that belong to distant centuries of the past.

The chief lines of work on which Barnes was engaged were salt lands and their reclamation; seepage and the rising of ground water-

level under irrigation conditions; the sugar cane and the sugar industry in the Punjab; the intensity of solar radiation; the Kangra tea industry; the chemical aspect of weevil attacks upon wheat. It is to be feared that his published papers and records will give no adequate idea of the comprehensive plans which he had in his mind in relation to the elucidation of these problems. He talked of them eagerly and in the most interesting way, showing at once his sound knowledge of fundamental science and his appreciation of practical conditions. He had erected a workshop and turned out from it many of the fine tools required in his work, and his laboratory methods exhibited the play of great experimental skill and resource. Space does not admit of any extended account of these investigations, but a little more may be said of one of them. On his last visit to Lyallpur in 1914 the writer was taken by Barnes to Narwala. This spot is twelve miles distant from Lyallpur, and is, or was, infertile salt-land, that is, land which owing to triumph of evaporation over rainfall has become impregnated with a variety of salts, carbonates, chlorides, and sulphates, especially of sodium, calcium, and magnesium, evident as a crust of "white alkali" or "black alkali" upon the soil. This condition of soil has been the subject of much study in America, but Barnes believed that the work had "failed to prove useful and practical for want of a better knowledge of the scientific principles of the causes of sterility. If such causes had been first investigated time and money would have been saved, and in the end the *practical* result would, as it always does, justify the scientist." Accordingly, Barnes set himself to study as closely as possible the physical, chemical, and biological aspects of the problem. Having satisfied himself of the principles involved, he applied himself to the practical problem of redeeming the land at Narwala, and at the time of the visit referred to a tract of infertile land was being mole drilled. Leaving fields where the leisurely ryot was urging his bullock to pull the wooden plough and gently scratch the surface soil, one passed to the Narwala tract where a Yorkshire artisan was found in contest, doubly bitter to him by the futility of his native tongue, with native inaptitude in dealing with a steam-driven mechanical monster from Leeds. The plan was to mole drain the land and then irrigate out so much of the salts as was shown by Barnes's biological methods to be necessary. The results of this trial were extraordinarily successful, and it is scarcely possible to believe that the luxuriant crops (of which photographs afterwards arrived) can have been grown on what was just before the war a stricken desert. Barnes in the end estimated that the system of reclamation would pay between 300 and 400 per cent. on the capital outlay, and its general application would, of course, add

millions to the wealth of India. He was proposing also to apply the system to non-irrigated areas by the use of water pumped from the subsoil.

In 1914 Barnes married Nora, daughter of the late Colonel Francis Thomas Steven, Indian Army.

As soon as the war began he bestirred himself to bring into action all the scientific and material resources that India could supply, but it is impossible at present to quote his important observations on this subject.

Shortly before his death Barnes, not without some reluctance on his part, left Lyallpur to take up at Pusa the post of chief agricultural chemist to the Government of India. What he might have accomplished from there it is idle to conjecture, but the thought of it only deepens the sense of calamity both to India and to Science that surrounds his untimely death.

Barnes was every inch a man and an Englishman. When the writer first saw him he had just come from among his students in the playing fields and was in football attire, a splendid figure of a man, eager, resolute, honest, and kindly. He was beloved by his students and colleagues and respected by everyone. In summing up his qualities in our mind it is impossible not to be struck with the strength and number of endowments that are needed to produce the type of man who is to be the true pioneer of progress in India—endowment of body, mind, and spirit. Happily, such pioneers have been found in the past. They will long be needed in the future of India, and it is difficult to think of any better service to mankind than is open there to those who can bring themselves to the standards that ruled the life and work of Hector Barnes. At Lyallpur his portrait and an annual prize have been set up to preserve his memory, and shortly before his death he was made a Doctor of Science of his University of Birmingham. His work and influence will endure in many fields and many hearts.

A. S.

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### GEORGE CAREY FOSTER.

BORN 1835; DIED FEBRUARY 9TH, 1919.

IN the death of Professor Carey Foster in his eighty-fourth year on February 9th, there are many who will feel the loss of a kind and generous friend, to whose gentle sympathy and encouragement much of the happiness, as well as much of the success, of their own lives has been due. A man of extreme modesty and of high

if not commanding ability, Carey Foster had made few direct contributions to scientific literature; but the soundness of his judgment, his almost passionate love of exact knowledge, and his enthusiasm, earned the respect of all, and made his presence invaluable on the many committees of learned societies, the British Association, and the various university boards of which he became a member. An extreme diffidence and a nervous shyness that was not without a peculiar charm to those who came to know him well, as well as a hesitation to express a definite opinion on subjects on which he did not feel on the firmest ground, made it easy to undervalue the services he rendered to science and education during the course of a long and active life.

George Carey Foster was the only son of George Foster, a calico printer and a Justice of the Peace for Lancashire and the West Riding of Yorkshire, and was born at Sabden, in Lancashire, in 1835. After an early education at private schools, he entered as a student at University College, London, where his studies were at first mainly directed to chemistry. He graduated in Honours and with a prize in chemistry in his twentieth year, and acted for some years as chemical assistant to Professor Alexander Williamson, who had then occupied the Chair of Chemistry for six years, and a warm attachment and regard sprang up between the two men. He left England in 1858, and spent some years in study at the foreign Universities of Ghent, where he was a student under Auguste Kekulé, at Paris, and at Heidelberg.

At this time, however, while he continued his chemical studies, his interest became more and more directed to physical science, which was then assuming a position of increasing importance through the work of such men as Clausius, Lord Kelvin, and Clerk Maxwell, and it was natural that the refined accuracy of physical measurements and the readiness which they admitted of mathematical treatment should have presented a strong attraction to a man of his type of mind. The first evidence of his new interest was the appearance in 1863 of two articles on "Heat" in the first edition of Watts's "Dictionary of Chemistry." These articles, extending together to more than 150 pages of closely printed matter, formed an admirably concise and critical statement of the position of an important branch of science, and at once established Carey Foster's reputation as a clear thinker and able exponent of physics.

In the meantime, in 1862, Carey Foster had accepted an invitation to assume the duties of professor of natural philosophy at the Andersonian University, Glasgow, and in 1865 he was encouraged by his friend and former teacher, Williamson, to

become a candidate for the vacant professorship of experimental physics at University College. His election was mainly due to the high reputation he had established as the author of the articles in Watts's Dictionary, and in October, 1865, he entered on his career at the London College, of which he was elected a fellow in 1867, and with which his name will always be associated. He resigned his professorship in 1898, at the age of sixty-three, but was recalled to act as principal of the college for a period of four years from 1900, during a critical time in its history. The last years of his life were spent in the quiet and refinement of a country life on a small estate at Rickmansworth, although, until quite near the end, he was always ready to place his services at the disposal of the educational causes that had been so near his heart in former times. He became a Justice of the Peace for Hertfordshire, and took an interest in politics, in which he was a supporter of the Liberal Party. Towards the end of 1917, after the death of his wife, he began to feel the weight of advancing years, but up to within two weeks of his death he was at work on manuscripts submitted to him for publication in the *Philosophical Magazine*. At the end of January of the present year he had a slight attack of congestion of the lungs, which his heart was not strong enough to resist, and, after gradually becoming weaker, he passed away in the presence of his children on February 9th.

Carey Foster's contributions to chemistry were published between 1857 and 1867. The writer, who is profoundly ignorant in chemical matters, is indebted to his friend, Dr. Forster Morley, for the following summary of these researches. Dr. Morley was engaged in several physical researches under the direction of Carey Foster while a student at University College, and was intimately acquainted with him during the remainder of his life.

"The first paper by Carey Foster appeared in the notes and abstracts appended to the British Association Reports for 1857. It is entitled 'On suggestions towards a more systematic nomenclature for organic bodies.' Gerhardt having introduced the term *homologous* to denote that two carbon compounds differed in their formulæ by  $\text{CH}_2$  or a multiple thereof, Foster now proposed a new adjective, *isologous*, to indicate a difference of  $\text{H}_2$  or a multiple of  $\text{H}_2$ . This adjective is still employed to denote the difference. He further suggested words composed of two Greek numerals, the first of which related to homology and the second to isology. Thus *deutritic* would mean 'belonging to the second homologous series and the third isologous series.' This suggestion, together with many other ingenious proposals for new nomenclature, did not receive support from other writers.



"In 1859 Carey Foster presented a preliminary report to the British Association 'On the Recent Progress and Present State of Organic Chemistry' (*Rep. Brit. Assoc.*, 1859, 1). This was a review of recent work, particularly from the point of view of the development of ideas about formulæ.

"In the Chemical Society's Quarterly Journal (1860, **13**, 235) we find a paper 'On Acetoxybenzamic, an Isomer of Hippuric, Acid,' by G. C. Foster. It is dated Ghent, 1860, and is an account of a very careful piece of work carried out under the direction of Professor Kekulé, and describes the first preparation of *m*-acetylaminobenzoic acid, which is shown to be related to hippuric acid, from which it might, in imagination, be derived by an interchange between the radicles of benzoic and acetic acids.

"A paper published in 1861 'On Piperic and Hydropiperic Acids' appeared in the Chemical Society's *Journal* (1862, **15**, 17; also in *Rep. Brit. Assoc.*, 1861, 78, and *Annalen*, 1862, **124**, 115). In this it is shown that piperic acid,  $C_{12}H_{10}O_4$ , is reduced to hydropiperic acid,  $C_{12}H_{12}O_4$ , and a large number of the salts of the latter are described.

"The most important chemical work carried out by Carey Foster is contained in three papers published in conjunction with Matthiessen. The first is entitled 'Preliminary Notice of Researches into the Chemical Constitution of Narcotine,' and was read before the Royal Society in 1860 (*Proc. Roy. Soc.*, 1861, ii, 55; *Phil. Mag.*, 1861, [iv], **22**, 398). In this the authors establish the formula  $C_{22}H_{23}O_7N$  for narcotine, and show that this alkaloid gives off methyl iodide when heated with hydriodic acid. The oxidation of narcotine to opianic acid is discussed, and the formula for opianic acid,  $C_{10}H_{10}O_5$ , correctly determined. It is also shown that, on heating with concentrated potash, opianic acid can be neatly split up into meconin and hemipic acid. A new acid, cotarnic acid, was obtained by the gentle oxidation of cotarnine.

"The second paper on this subject, entitled 'Researches into the Chemical Constitution of Narcotine and of its Products of Decomposition,' was published in 1863 (*Phil. Trans.*, 1863, 345; an abridgment is given in *J. Chem. Soc.*, 1863, **16**, 342). The authors here describe how, by acting on hemipic acid with hydriodic acid, an acid,  $C_7H_6O_4$ , which they call 'hypogallic acid,' but which is now known as protocatechuic acid, is obtained. As an intermediate product they isolated 'methylhypogallic acid,' now called 'isovaleric acid.'

"The third paper is entitled 'Researches into the Chemical Constitution of Narcotine and its Products of Decomposition, Part II,' and was read before the Royal Society in 1867 (*Proc. Roy.*



*Soc.*, **16**, 39; *J. Chem. Soc.*, 1868, **21**, 357). It is shown that opianic acid, when heated with hydrochloric or hydriodic acid, forms methyl chloride or iodide, and a new acid, 'methylnoropianic acid,'  $C_9H_8O_5$ . Thus, opianic acid may be called dimethylnoropianic acid. Methylnoropianic acid yields with nitric acid nitromethylnoropianic acid. Meconin, on heating to  $100^\circ$  with concentrated hydrochloric or hydriodic acid, yields methyl chloride or iodide and methylnormeconic acid, or, rather, methylnormeconin,  $C_9H_8O_4$ . By similar means, narcotine can be converted into methylnornarcotine,  $C_{20}H_{19}O_7N$ .

"These three papers by Foster and Matthiessen made a long step forward in the knowledge of the constitution of the alkaloids, and may, indeed, be termed classical. The accuracy of the work has been amply confirmed by subsequent investigation.

"While this work was in progress, Carey Foster published two papers, entitled 'On Chemical Nomenclature, and chiefly on the Use of the Word *Acid*.' Both appeared in 1865 (*Phil. Mag.*, [iv], **29**, 262; **30**, 57). In these he protests against the word *acid* being used to denote an oxide, and recommends that  $SO_2$  be called sulphurous oxide,  $SO_3$  sulphuric oxide, and  $C_4H_6O_3$  acetic oxide.

"In 1869 Carey Foster took part in a discussion on the atomic theory, held at the Chemical Society, the subject having been introduced in a lecture by Professor A. W. Williamson. An account of the discussion will be found in the *Chemical Society's Journal* for 1869.

"Carey Foster's work in chemistry shows that if he had decided to devote himself to that science he would have taken a distinguished position among his colleagues. He was a member of the Council of the Chemical Society from 1865 to 1868, again from 1872 to 1875, and again from 1885 to 1886, and Vice-President from 1888 to 1890. His Fellowship of the Society dates from 1856."

During the early years at University College, Carey Foster made a number of contributions of minor interest to scientific journals, but his first important paper, "On a Modified Form of Wheatstone's Bridge, and Methods of measuring Small Resistances," was read before a meeting of the Society of Telegraph Engineers in 1872 (*Telegraph Engineers' Journal*, 1872—1873, **1**, 196). Previous to this date, Wheatstone's bridge had provided electricians with a convenient and fairly accurate method for comparing resistances, and, as is well known, the result of the experiment expresses the ratio of one resistance to the other. Carey Foster,

however, so modified the bridge method that the difference between instead of the ratio of the resistances was determined. The advantage of the change is only apparent where the resistances to be compared are of nearly equal value, as is generally the case, for instance, in the testing of standard coils; but where this condition is fulfilled, the new method transformed the bridge method from being merely a fairly accurate means of measurement into one of the most refined accuracy, comparable with that attained in the use of a sensitive balance. It also supplied the means of dealing with a very small resistance, such as that of a short, thick wire, by determining the difference between it and the zero resistance of a short copper bar, and it was, indeed, for this alone that the method was first suggested. Carey Foster's method has proved of the highest value to the science of exact electrical measurement, and has made it possible to issue standards of electrical resistance of an accuracy that would otherwise have been impossible of attainment. Alike in its simplicity and its refined accuracy, the method is thoroughly characteristic of his mind. He further showed how the principle involved might be applied to the important process of calibrating the wire of the bridge.

In 1881 Carey Foster published "An Account of Preliminary Experiments for the Determination of the Electromagnetic Unit of Resistance, in Absolute Measure" (*Rep. Brit. Assoc.*, 1881, 426). The accurate determination of this important unit had been undertaken by the British Association in 1863, and the value that had been accepted in this country, as well as widely in other parts of the world, was expressed in the "B.A. unit of resistance," the value of which had been determined by a Committee of the Association consisting of Clerk Maxwell, Fleeming Jenkin, and Balfour Stewart. The classical method of experiment adopted by the Committee consisted in revolving a large, flat, closed coil of insulated copper wire about a vertical diameter in the earth's magnetic field and measuring the consequent deflexion of a magnet suspended at its centre. The deflexion was due to the induced current developed in the coil, and this depended on its resistance as well as on the intensity of the earth's magnetic field. The last, however, affecting the induced current and the deflexion equally, although in opposite senses, disappeared in the final equation that expressed the result of the experiment, leaving a relation between the resistance of the coil, its geometrical form and dimensions, and the speed of its revolution.

During the years that had elapsed since the issue of the B.A. unit, the results of other measurements had led to a growing conviction that it was appreciably too small, and Carey Foster

described an experiment in which, whilst the general principle of the British Association experiment was maintained, it was modified in an important detail. The two ends of the wire composing the coil were unconnected throughout the greater part of its revolution; but for a short interval, the centre of which coincided with the transit of the plane of the coil through the magnetic meridian, they were placed in connexion through sliding contacts with the two ends of a standard resistance coil that formed part of an "auxiliary" circuit in which a steady current was maintained by a thermopile. By the principle, originally applied by Poggen-dorff in the potentiometer, no current is developed in the coil if the electromotive force developed in it by its rotation in the earth's magnetic field is equal to the fall of potential between the two points in the auxiliary circuit with which it is connected, this being the product of the current supplied by the thermopile and the resistance of the standard coil, and the method of experiment consisted in so regulating the current of the thermopile that the deflexion of a sensitive galvanometer included between the revolving coil and one of its points of connexion with the auxiliary circuit should disappear, whilst at the same time the deflexion of the magnet of a tangent galvanometer included in the auxiliary circuit was recorded. The general principle is simple, and a relation is readily established between the resistance of the standard coil, the deflexion of the magnet of the tangent galvanometer, the geometrical form and dimensions of the revolving coil, and its speed of revolution.

The chief refinement that Carey Foster hoped to effect in this modification of the original experiment consisted in the possibility of the *direct* determination of the resistance of the standard coil. In the original experiment, the resistance determined was that of the revolving coil, and the resistance of the standard could only be obtained by subsequent comparison. To obtain the maximum induced current, it was essential that the revolving coil should be wound with copper wire, and as the resistance of copper with that of all pure metals is seriously affected by changes of temperature, it was necessary that the temperature of the coil should be known with great accuracy during the time that the experiment was in progress, a very delicate matter. In Carey Foster's method, however, the resistance of the standard coil was directly determined while it formed a part of a fixed and independent circuit. The wire composing it might equally well be of copper or of one of the many alloys the resistances of which are scarcely affected by changes of temperature, whilst it was an easy matter to determine its temperature with great accuracy. Further, the new method

reduced the correction for the self-induction of the revolving coil, an important and rather delicate detail in the original experiment, to insignificant proportions, but, at the same time, it unfortunately introduced the necessity of taking its capacity into consideration, a feature that Carey Foster did not probably at first realise.

The apparatus for carrying out the experiment was constructed with great refinement, and was erected at University College, and a series of preliminary experiments were made by Carey Foster with the assistance of Mr. G. W. von Tunzelmann. These experiments showed that the method was capable of yielding consistent results, and there is no doubt that a far higher consistency would be possible if they were repeated in a modern laboratory more completely removed from the disturbing magnetic influences of large masses of iron of continually varying temperature. The results were not, however, sufficiently consistent to satisfy the critical judgment of Carey Foster, and the experiment was abandoned. Whilst they were in progress, Lord Rayleigh and Professor Schuster were engaged in repeating the original experiment, adopting precautions that experience of the intervening years had been shown to be necessary, and in 1882 they published an account of their experiments, and during the next ten years independent evidence supplied by other methods has shown the value they obtained to be a close approximation to the truth.

In 1886 Carey Foster contributed a paper to the Physical Society of London "On a Method of determining Coefficients of Mutual Induction" (*Phil. Mag.*, 1887, [v], **23**, 121—129), the method depending on the comparison between the coefficient of mutual induction of two coils and the capacity of a condenser. On forming or breaking a current in one of two coils, the primary, a discharge of electricity takes place through a neighbouring, secondary, coil, the discharge being determined by the coefficient of mutual induction of the two coils; also, if the coatings of a condenser are connected to two points of the primary circuit, a charge, proportional to the resistance of that part of the circuit that is included between the two points of connexion, enters the condenser, and will be discharged on the cessation of the primary current. To combine these two examples of "Ballistic" discharge, Carey Foster succeeded in so connecting the two circuits that, on the break of the primary current, the condenser was discharged through the secondary circuit in the opposite direction to that of the induced discharge, and on varying the charge of the condenser by regulating the resistance between the points of its connexion with the primary circuit, its discharge and that of the induced current neutralised one another.

The disappearance of discharge in the secondary was indicated by a galvanometer, and a simple relation was given between the coefficient of mutual induction of the coils and the capacity of the condenser. The capability of the method had been thoroughly tested at University College by Mr. F. Womack, and it had been shown to be capable of yielding results of a high order of accuracy. Carey Foster's method of determining the coefficient of mutual induction between two circuits has taken its place among the accurate methods of electrical measurement.

In 1876 Carey Foster devised a method, based on the principle of Wheatstone's bridge, of tracing the equipotential curves in a sheet of tinfoil conveying an electric current, and in collaboration with Sir Oliver Lodge he published two papers, "On the Flow of Electricity in a Plane Conducting Surface" (*Proc. Phys. Soc. London*, 1876, 1, 113, 193), in which this method of experiment was adopted. A further paper by Carey Foster and the present writer, "On the Difference of Potential required to give Sparks in Air," was presented to the Physical Society in 1884 (*Chem. News*, 1884, 114). In the method of experiment adopted in this research, potential differences were measured by a modified form of absolute electrometer that had been designed by Carey Foster and that was found to supply an accurate method for measuring potential differences necessary to produce sparks of from 0.1 to 5 cm. in length.

Among Carey Foster's other publications were further articles on "Heat," "Thermodynamics," "Electricity," and "Magnetism" in later editions of Watts's "Dictionary of Chemistry," and in these he fully maintained his reputation for accuracy, clear judgment, and power of scientific exposition. In later years he published a text-book on electricity in collaboration with Professor A. W. Porter.

Carey Foster became a member of the British Association in 1857, and continued to take an active part in its proceedings until late in life. Besides his direct contributions, to which reference has already been made, he was a member of a number of its committees, the more important of which were those on "Standards of Electrical Resistance," "The Selection and Nomenclature of Dynamical and Electrical Units," "The State of Knowledge of Spectrum Analysis," and "Electrolysis." As President of the Mathematical and Physical Section in 1877, he gave an address on "The Mutual Relation between Mathematics and Physics," in which he dwelt on his favourite theme of the importance of accurate measurement as the foundation of discovery in science. He was Treasurer to the Association from 1888 to 1904. He was one of

the founders of the Physical Society of London, the first meeting of which was held in 1873, and of which he was President for two years from 1887. He acted as President of the Society of Telegraph Engineers, now the Institute of Electrical Engineers, in 1880 and in 1881. He was elected to the Fellowship of the Royal Society in 1859, acting as one of its Vice-Presidents from 1891 to 1893, as well as from 1901 to 1903, and he took a keen interest in the work of Kew Observatory Committee of the Society. He received the honorary degrees of LL.D. from Glasgow and D.Sc. from Manchester.

From the first, Carey Foster took a deep interest in the reconstitution of the University of London. Whilst fully recognising its services to education in its earlier days, he was sensible of the grievous anachronism by which the University of the greatest city of the world should continue to be solely engaged in examining and in conferring degrees. He had a high ideal of a university as a body of men and women earnestly engaged in the pursuit and extension of knowledge rather than in preparation for examinations, and he strove without ceasing to bring about the foundation of a university in London that should be worthy of it. He was an active member of the many early committees the aims of which were a constructive policy that should achieve his ideal, and he felt keen disappointment when the conflicting of many interests made it impossible of full attainment in the present university, although it received his full and loyal support. He never ceased, however, to look forward to a time when, by further reconstruction, London should possess a university fully worthy of its position, and he welcomed Lord Haldane's Report as indicating the possibility of a further step in this direction, and possibly its full attainment.

The writer is indebted to Sir T. Gregory Foster, Provost of University College, for a sketch of Carey Foster's work while acting as Principal of the College from 1900 to 1904.

"Dr. G. Carey Foster resigned the Quain Chair of Physics in 1898. It was a time of crisis in university affairs in London, as the reconstitution of the University was pending.

"In view of the impending reconstitution, the Council of University College appointed a special committee to consider the position of the College. On the recommendation of this committee, the office of Principal, later changed to Provost, of the College was instituted. Dr. Carey Foster was invited to be the first occupant of this office. He held it from 1900 to 1904.

"In his capacity of Principal, he was appointed to represent University College on the Senate of the University under its new

constitution. He threw himself heartily into the new problems that arose, and brought to them all his ripe judgment and experience.

“It soon became evident that the new constitution, under which the University was given a teaching side as well as an examining side, made it desirable that University College, which had been originally founded to be the University of London, should be merged into the reconstituted University. Dr. Carey Foster took an active share in the negotiations that led up to the incorporation of the College in the University. He regarded it as ‘a step towards securing unity of aim and interest in all that relates to advanced education and the promotion of original research in London.’ He hoped that it was the beginning of a movement that would lead to the concentration and the consolidation of university work in London.

“This view is expressed in the final paragraph of his sketch of the History of University College, which is as follows:

“‘The step taken by University College has been followed by King’s College, which was incorporated in the University on September 1st, 1909. It may be hoped that similar action will be taken by other analogous bodies, and that in course of time the University of London, perhaps with some modification of its present constitution, may become a centre about which the various bodies in London that are qualified to take part in university work may be united into a single organised system, in which they shall supplement instead of competing with each other, each doing the work for which, by its special circumstances, it may be best fitted.’

“During the four years of his Principalship, great progress was made in various directions in the reorganisation and development of university work in London. The plans for the removal of University College School were matured. The buildings formerly occupied by the School were, as a consequence, set free for university purposes. The accommodation provided at University College for university work was materially increased. There was a rapid growth in the intellectual and social activities of the College, and in these Dr. and Mrs. Carey Foster took a prominent share.”

At an early period of his work at University College, Carey Foster recognised the importance of practical work in physics as an essential element in scientific education. The first physical laboratory for students had been opened by Magnus at Heidelberg in 1846, and it was followed in 1863 by the addition of a physical laboratory to the University of Berlin. From 1845, Lord Kelvin



had invited his senior students to work in his laboratory, for a time a disused wine cellar, at Glasgow, and his example was followed by Carey Foster, who thus introduced the teaching of practical physics in this country. At the beginning, this work formed no recognised part of the College curriculum, but regular practical courses in physics were arranged in 1867, the laboratories at that time consisting of two of the College rooms, only one of which was fitted with benches. Later, a third room in the basement, known as the "dungeon"—it was indeed a veritable dungeon—was added, and the privilege of working in it was reserved for the professor and students engaged in research. For some years, the only apparatus available was of the simplest character, but instruments were being constantly designed by Carey Foster himself, whilst the designs were executed by a clever Scotch mechanic, William Grant, who acted as his assistant during the whole time of his professorship, and without whom no reference to the laboratory would be complete. Grant, who was quite a character in his own dour way, became a permanent feature of the Physical Department. His love of the apparatus, so much of which he had constructed, and the agony he experienced in seeing it misused, made him a source of terror to all students other than those few who proved themselves worthy to be entrusted with it; whilst many will remember with humiliation his lofty refusal of the tip that was occasionally offered, either from gratitude or from a desire to acquire merit. He was of the most faithful of servants, and was devoted to Carey Foster, whilst each regarded the other with a simple affection of which both alike were worthy. Sir Oliver Lodge, who was a student in the laboratory in those days, and who later became Assistant Professor of Physics at the College, has rendered a grateful as well as a graceful tribute to the educational value of the work done in the old physical laboratory of University College (Letter to *Nature*, December 3rd, 1908).

In the years that followed, physical laboratories for students were opened at other colleges, and it was inevitable that, as many of these were attached to new institutions in which it had been possible to design the buildings with a view to their subsequent use as laboratories, the simple equipment at University College should have been left behind. Carey Foster, in consequence, continually urged the governing body of the College to undertake the building of a physical laboratory that should be worthy of its traditions, although, no doubt by reason of financial considerations, his representations were for a long time without success. At length, however, he had the satisfaction of preparing the plans for the present laboratories, which were opened to students in

1893, and form a fitting memorial to the value of his work as Professor of Physics. There was an old asphalted tennis court within the College walls from which some of us have often returned in exhilaration, although with begrimed hands and flannels, and now only lives in memory; the building that now occupies its former site is the "Carey Foster" Laboratory.

His nervous manner prevented Carey Foster from ever becoming a good lecturer, and his failure in this respect was perhaps due, in addition, to a conscientiousness that made it difficult for him to be content with a simple statement that he knew to be only an approximate expression of a truth, and at the same time made him reluctant to adopt the customary method of illustrating physical laws by the use of simple, although entirely imaginary, experimental data. In place of these, his illustrations would often consist of the actual results of laboratory measurements, and the younger students, unless they were of a rather exceptional type, were apt to lose both attention and interest in the details of laborious computation. The more able students, however, were inspired by this very quality in their teacher. They grew to reverence exact expression and to regard it as the foundation of all scientific knowledge. They continually brought their difficulties to the Professor, and were encouraged to do so by his unlimited patience in dealing with them. It was not unusual to find Carey Foster surrounded by a small group of students engaged in close discussion half an hour after the close of a lecture, although the dining-room had long since claimed the attention of the rest of the College.

The same quality of enthusiasm for his work and his infinite patience in dealing with its smallest details appeared in his work in the students' laboratory. He never found lecturing easy, but after having given a lecture in the morning and having a further lecture for senior students in prospect at the close of a long afternoon, he would frequently come to the help of some duffer in difficulties in the laboratory, and would devote the best part of an hour to the details of a simple experiment in physical measurement. On these occasions, indeed, there was a danger of his being led by his own love of accurate detail, not only to conduct the whole experiment himself, making all the observations, but to carry out whatever computation might be involved, while the student looked on wonderingly, as from a distance. It may be that some who have worked in the old laboratory at University College in those days have preserved the scraps of paper covered with logarithmic calculations that Carey Foster often left on the

benches, all executed in his wonderfully neat writing, as a memento of the most patient of teachers and most lovable of men, but such prescience is rarely bestowed on youth.

His nervousness made conversation with Carey Foster difficult, even to those who came to know him intimately. Whilst, however, it remained a source of some embarrassment to them, his friends came to regard it as so essentially a part of him that it too became lovable, and they would have felt still more embarrassed if he had suddenly succeeded in overcoming it. Closely associated with his manner was a quaint and entirely original sense of pure humour, that found frequent opportunity for expression both in his professional work and in his private life. That his nervousness and hesitation did not arise from any defect in character would be shown, were any such evidence necessary, from his letters. In these, Carey Foster found no difficulty in expressing himself with perfect clearness and precision, whilst both were emphasised by the beauty and strength of his handwriting. It was in his letters, perhaps, that his quaint humour found its best opportunity for expression. Through the kindness of Mrs. Minchin, the writer has before him a number of letters written by Carey Foster to her husband, the late Professor G. M. Minchin, which are so characteristic that little apology is necessary for the introduction of a few short extracts. A close friendship existed between Carey Foster and Minchin, and in their unassuming simplicity and gentleness there was much resemblance between the characters of the two men. Carey Foster had a profound respect for Minchin's mathematical powers, and consulted him when he felt a doubt as to his own grasp of the mathematical treatment of a physical problem, whilst Minchin had an equally deep regard for Carey Foster as an authority on physical matters, and has expressed his regret to the writer that Foster's nervous manner, together with his extreme modesty, should have made it difficult for some, even of his friends, to realise his true greatness.

The first extract is from a letter dated 1882:

“My dear Minchin,

“The lesson of the day touching electric endosmose is written in the First Book of Wiedemann, beginning at the 392nd verse of the second chapter . . . wherein it is written how the ions do wander when a current passeth through their midst. This, I take it, is the whole secret of electric endosmose; the porous diaphragm causeth not the flow, but maketh the same manifest by hindering the return thereof.”

The second is also dated 1882 :

“My dear Minchin,

“I hope the enclosed may serve your riverence’s purpose. Sure, and it’s bad I did not write before. But I had to think, and that goes slow.

\*            \*            \*            \*            \*            \*

“As to your telegraphic friend ; let him take to himself a tangent galvanometer and a set of resistance coils, and sundry cells according to Daniell and Grove. . . .”

and then follow instructions as to what the telegraphic friend should achieve.

An extract from a letter referring to a fairly well-known man :

“The gentleman’s surface integral suggests to me a considerable amount of self-esteem. But I am willing to believe that the charge is purely superficial. . . . I am told by a friend who knows him much better than I do that he is a good fellow.”

And the last is from a letter written in 1887 congratulating Minchin on his marriage :

“My dear G. M. M.,

“I heard awhile ago that you had entered into combination and were no longer a dissociated atom. Accept my warmest congratulations and my fervent hope that you may appreciate the blessings of home rule more fully from year to year.”

Several of the letters deal with Minchin’s work with photo-electric cells.

The private life of Carey Foster was one of quiet beauty. His transparent honesty and high regard for truth earned him the respect of his friends, whilst his unvarying kindness and courtesy won their affection. In 1868 he married Mary Anne Frances, daughter of Andrew Muir, of Greenock. Recalling that time, Dr. Forster Morley writes :

“It seems only yesterday when my father (the late Professor Henry Morley) said to me, ‘I have been walking round the Square with Carey Foster, who has just told me that he is engaged to be married, and has been speaking most charmingly on the subject of love of a man for a woman.’”

There was a striking resemblance between the character of Mrs. Foster and that of her husband, and she even acquired a suspicion of the nervousness that was so strongly marked in him, that, however, only accentuated a natural charm of manner in her. There were born to them four sons and four daughters, all of whom are still living. The mutual confidence that existed between Carey Foster and his wife, and the evident affection with which both parents were regarded by their children, gave a peculiar charm to the visits of the many friends who were always welcome to their home. Mrs. Foster died in 1917, and a year and a-half later Carey Foster's body was laid to its last rest beside hers in the peaceful cemetery at Rickmansworth.

Among the number of Carey Foster's old students at University College who have become distinguished were Prof. W. E. Ayrton, Sir Oliver Lodge, Dr. H. Forster Morley, Prof. Viramu Jones, Prof. A. P. Chattock, Prof. J. A. Fleming, Prof. T. Hudson Beare, Prof. A. W. Porter, Prof. F. Womack, Prof. J. Sakurai, Sir Victor Horsley, and Prof. W. D. Halliburton. It is from his having been first a student, then a demonstrator, and thereafter a friend of Carey Foster that the writer has been able to pay in this notice his last tribute to the memory of one he loved and admired.

A. H. FISON.

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### WILLIAM JOEL KEMP

BORN 1841; DIED MARCH 22ND, 1918.

WILLIAM JOEL KEMP was born at Bow in 1841. He was the youngest of three sons, and was educated at Stock's Academy at Poplar. Owing to his father's death, he left school at a very early age, and was placed in the office of a ship's broker. Finding this work very uncongenial, he induced his relatives to article him to Carters and Green, builders of the famous China tea clippers, in the yard which subsequently became the headquarters of the Thames Ironworks and Shipbuilding Company. His apprenticeship commenced at an unfortunate time, for wood was rapidly being replaced by iron in the construction of ships, and the old-established firms which did not move with the times were being left behind. All the same, this period of his life must have been a particularly happy one. He met all sorts of seafaring men, and in later life he never tired of relating anecdotes connected with their superstitions and adventures, and it is not unlikely that their experiences quickened

the sense of imagination which served him so well in after years. Shortly after completing his articles he married Mary, the daughter of John Cayzer, who organised the emigration to Australia of the East Anglian farm labourers in the starving 'forties and 'fifties. About this time he entered the service of Rickett Smith and Company, coal and coke shippers, as buyer. In this capacity he was brought in contact with the lime burning, plaster, and kindred industries, and when in 1876 a company was formed to work the bed of gypsum discovered four years earlier through the Sub-Wealden boring at Netherfield, Sussex, he took a small financial interest in the undertaking. It was about this time that the necessity for technical education and scientific training was first accepted in England. In 1879 the City and Guilds of London Institute for the Advancement of Technical Education was formed, and almost immediately courses in chemistry under Armstrong in temporary premises in Cowper Street, Finsbury, were advertised. Although nearly forty years of age, Kemp, knowing that the manufacture of plaster at Netherfield rested entirely on rule-of-thumb methods, determined to take advantage of the facilities which the City Guilds Institute afforded and to become an efficient chemist. At Cowper Street he worked for one or two days a week, encouraged and inspired by Armstrong, and he soon proved himself to be not only a logical thinker, but an expert manipulator. The other students in the laboratory were all boys, and the writer, who worked at the bench adjoining Kemp's, shared with them the admiration of his power of application and of his rapidly acquired skill. Kemp, influenced by Armstrong's spirit of research, soon began to make investigations on the production of sulphur from gypsum and from alkali waste, and these occupied him for several years. He was the first to suggest making alkali waste into a paste with water and pumping carbon dioxide into the sludge contained in an inverted conical vessel, thus making the gas do its own stirring and bringing every particle of the waste in contact with it. Some of the results of these investigations were subsequently embodied in Rawes's patents, which were worked by Chance. During these years, the position of the Sub-Wealden Gypsum Company at Netherfield had become very critical, the output had fallen below 40 tons a month, the quality of the plaster was bad, and creditors were clamouring for payment of their accounts, which there were no funds to meet. There was already on the bank an immense tonnage of dump, a grey stone considered useless, which had to be hauled to the surface with the white gypsum, and it was becoming increasingly difficult and expensive to dispose of it on the surface. A meeting was held with the object of winding up the company,

but Kemp, who had already begun to experiment with the grey stone, which consisted almost entirely of gypsum, persisted in the view that under proper direction the operations of the company would be successful. Two of the shareholders present were impressed, and agreed to provide further funds if Kemp would undertake the management, and it was thereupon decided that operations should be continued. Kemp's experiments with the grey stone were now pushed on, with the result that in a short time he had perfected a method whereby the waste was converted into a plaster of the Keen's cement variety, which, although dark in colour, set hard and evenly. He introduced this plaster under the name of "Sirapite," and from that day the success of the undertaking was assured. In 1891, 10 tons of "Sirapite" were sold; ten years later the annual sale was 15,108 tons, and in 1911 the sales exceeded 31,000 tons. Kemp's genius was shown not only in the way he attacked his problems on the chemical side, but also in his engineering ability and in the handling of men. From the first he recognised the inefficiency of boilers fed with water almost saturated with calcium sulphate, and within two years of taking control he had scrapped the steam plant and had substituted gas producers and large gas engines. He introduced kilns of large size, which reduced the consumption of fuel and greatly simplified the grinding and mixing plant. He subsequently opened up a new shaft in the mine, which he equipped with electric lighting and haulage plant. Having placed the business on a profit-earning basis, Kemp devoted his attention to the amelioration of the condition of his workpeople. Although himself prepared to work twelve hours a day or more, he reduced in 1895 the working hours to eight and afforded all workmen suitable opportunities for recreation. At his suggestion, the company built a large number of model houses standing in large gardens, which the workpeople were permitted to purchase at cost price. In 1903 Kemp completed his plans by bringing about an amalgamation of the chief makers of plaster in the United Kingdom.

Very few of those who travel by the South-Eastern Railway from Tunbridge Wells to Hastings realise that near Mountfield, hidden from, but within a few hundred yards of, the line, and in one of the most beautiful of the Sussex valleys, lie a mine fully equipped and busy works employing several hundred hands, at which a large part of the plaster used in this country is produced. It was here that Kemp conducted his experiments which revolutionised the industry, and it was here, at the scene of his life's work, that he breathed his last. Shortly after the outbreak of war his son, who for some years had assumed the management, volunteered for



service, and Kamp, then seventy-five years of age, returned to take charge. Always confident and cheerful, ever hard-working, he resumed his former duties with an activity and interest which might have been expected from a man thirty years his junior. On the morning of March 22nd, 1918, he rose in the usual health and spirits, but shortly afterwards, when about to go the round of the works, he suddenly expired.

GERALD T. MOODY.

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### SYDNEY LUPTON.

BORN JANUARY 3RD, 1850; DIED JULY 10TH, 1918.

SYDNEY LUPTON, who was elected into the Society in 1872 and remained a Fellow until his death, was the youngest and last surviving son of Darnton Lupton and of his second wife, Anna Jane Busk. He was born at Eller Close, Roundhay, near Leeds, on January 3rd, 1850. His father, a member of a well-known Yorkshire family, was head of the firm of William Lupton and Co., woollen manufacturers. He was a man of considerable influence and public spirit, much respected, and took a leading part in the municipal politics and social life of the town and district.

His son, the subject of this notice, was educated at Rugby and lived in Dr. Jex Blake's house. From Rugby he passed to Oxford, where at Christ Church he came under the influence of Dr. Vernon Harcourt, and was led to devote himself to science, particularly to mathematics and chemistry.

On leaving the University, after taking his degree, he was appointed a science master at Harrow School. The work of school teaching was not uncongenial to him, and he had a fair measure of success in it; but his mother—now a widow—having fallen into indifferent health, he resigned his position in order to live with her at Harehills, near Leeds, where he established a small laboratory and continued to occupy himself with experimental work.

It was during this period that the writer of this notice made his acquaintance, and had the opportunity of observing the progress of his inquiry on the slow oxidation of potassium, the longest and perhaps the most important of his investigations. On the death of Mrs. Lupton he took a smaller house at Roundhay, where he continued to live until his removal to London in 1896.

During his residence in Leeds, Lupton took part in the civic life of the town, was a member of the Board of Guardians, and

was associated with the late Canon Jackson, Vicar of St. James's, in many charitable objects. For four years he was a member of the Committee of Management of the Cookridge Convalescent Hospital, and on his resignation, consequent on his leaving Leeds, his fellow-members recorded their appreciation of his genial and energetic help and their sincere thanks for his services "during a period requiring special administration." This last sentence has reference to the assistance he was able to render the institution in connexion with the erection of a wing to the building to perpetuate the memory of his friend, Canon Jackson.

Lupton's intellectual tastes led him to take an interest in the activities of the Leeds Philosophical and Literary Society, where he occasionally lectured on scientific subjects. He became a member of its Council in 1885-6, Honorary Secretary from 1886-95, and a Vice-President in 1895-6.

Practically the whole of Lupton's experimental work was done during his residence at Leeds. His first published paper, "On the Formula of the Alums," appears in the *Journal* of the Society for 1875. Although the doctrine of valency, which we owe to Frankland, was fairly well established at this period, there was considerable uncertainty as to the true formulæ of a number of inorganic compounds, owing to doubt as to the valency of particular elements. This was the case with the group of the alums. Lupton, at the suggestion of Dr. Vernon Harcourt, sought to establish the generic formulæ of these salts, independently of considerations of the combining values of their constituents, by a study of the conditions under which they lose their water on heating or on exposure to a dehydrating agent under reduced pressure, and he showed conclusively that they must contain at least twenty-four molecules of water, whence the general formula now universally accepted follows.

In the same year he published a note on the preparation of cuprous chloride, in which he described the different mode in which water acts on this substance, depending on its method of formation (*Chem. News*, 1875, **30**, 233). This was followed in 1876 by a number of short notices (*Chem. News*, 1876, **33**, 90). He showed that in preparing nitrogen by the well-known method of passing air over red-hot copper turnings, the operation might be rendered continuous by mixing the air with ammonia gas, whereby the cupric oxide was reduced as fast as it was formed, or, as is more probable, by the metal acting catalytically and inducing the production of water:



In this manner, only a relatively short length of heated copper turnings is needed, and the action proceeds uninterruptedly.

In another communication, on the "Solubility of Naphthalene in Water," he sought to disprove Garden's contention that Plateau's theory of the cause of the movement of this substance on the surface of water was invalid by showing that its solubility, and consequent high tension of its solution, are sufficient to account for the phenomenon.

He further described a number of reactions serving to distinguish aniline from naphthylamine, and made known a number of characteristic tests for succinic acid.

Lupton's most important chemical paper was his study of the "Slow Oxidation of Potassium," communicated to the Society in 1876 and published in the *Journal* for that year, in which he carefully repeated the observations of Davy, Berzelius, Gay Lussac and Thénard, and Harcourt, and sought to clear up certain discrepant statements with regard to the number of potassium oxides capable of existence. He confirmed Vernon Harcourt's work, made fourteen years previously (*Quart. Journ. Chem. Soc.*, 1862, **14**, 267), carefully watching the colour changes which follow the progress of the oxidation, and analysing the products at the several stages by a method he devised, and of which he proved the sufficiency. He was disposed to regard the existence of the grey suboxide,  $K_4O$ , of Berzelius as improbable, and he concluded that the intermediate products of oxidation were mixtures of  $K_2O$  and  $K_2O_2$  in variable proportion, depending on temperature and time and the nature of the oxidising medium. He compared these intermediate products with the successive stages in the oxidation of lead and with the several lead oxides described by various observers, the general nature of the change being similar. He obtained analytical numbers for the yellowish-green product which corresponded with the composition of a dioxide,  $K_2O_2$ , and described a number of reactions which appeared to indicate its individuality. He gained no certain proof of the existence of the trioxide,  $K_2O_3$ , but was inclined to regard the brownish-yellow stage of the colour change as some evidence of its formation. He states that "the more thoroughly the air is dried, the less is its oxidising action," as proved by Baker (*Phil. Trans.*, 1888), and subsequently by Holt and Sims (T., 1894, **65**, 434), who showed that potassium may be distilled unaltered in perfectly dry oxygen.

Lupton's conclusions have been confirmed, in the main, by the last-named observers, although they found it impossible to associate the differences of colour with oxides of definite composition, the oxidation proceeding apparently without any break until the

heated mass consisted wholly of the bright orange-yellow peroxide,  $K_2O_4$ , described by Harcourt.

Holt and Sims also repeated Lupton's experiments on the action of the oxides of nitrogen on heated potassium, and with nitrous oxide obtained evidence of the formation of the buff-coloured trioxide and the sulphur-yellow dioxide, the existence of which in solution had already been established by Harcourt.

Lupton, in 1888, published a short communication in the *Proceedings* of the Society on compounds of chromium, and in 1891 he contributed to the *Philosophical Magazine* a controversial paper on "The Reduction of the Results of Experiments, with Special Reference to the Hydrate Theory of Solution" (*Phil. Mag.* [v], **31**, 418), which produced a rejoinder from Mr. Spencer Pickering.

Sydney Lupton was a painstaking and conscientious worker, scrupulously accurate, and a good manipulator, cautious in drawing conclusions or in forming opinions, but very tenacious in holding them when convinced of their soundness. His knowledge and, as his published work shows, his sympathies were almost exclusively confined to inorganic and physical chemistry; and owing probably to the limitations of his early training and his subsequent lack of opportunity, he never seemed to be attracted by the problems of modern organic chemistry.

As a fellow-townsmen and a member of the well-known Mill Hill Chapel, he was a great admirer of Joseph Priestley, who formerly ministered in Leeds, and began his chemical career there. At one time he conceived the idea of writing the life of the old philosopher and of bringing out an annotated edition of his complete works, for which he had gradually accumulated material. But to do justice to Priestley's astonishing versatility and the extraordinary range of his knowledge requires an equally exceptional man, and Lupton, after playing with the project for some time, finally relinquished it, being deterred from the attempt in all probability by its very magnitude. He was, however, well qualified to make it, especially as regards Priestley's scientific work and philosophical opinions, for he had considerable critical acumen and literary skill, was an omnivorous reader, and had extensive knowledge of the literature and science of the latter half of the eighteenth century.

On his removal to London, Lupton ceased to take any active part in experimental inquiry. He kept up his interest, however, in scientific work, was a frequent attendant at meetings of scientific societies, and at the lectures of the Royal Institution. He also interested himself in Bedford College, and in the work of St.

George's Hospital, and was for a time a member of its Committee of Management.

He was, perhaps, most generally known by his books on "Elementary Chemical Arithmetic" and "Numerical Tables and Constants in Elementary Science," published by Macmillan's, and based probably on his experience in science teaching at Harrow. His last production was a little book of some 120 small 8vo pages bearing the modest title, "Notes on Observations, being an Outline of the Methods used for determining the Meaning and Value of Quantitative Observations and Experiments in Physics and Chemistry, and for reducing the Results obtained." Notwithstanding the somewhat archaic ring of its title, it is an admirable piece of work, and well worthy of careful study by all engaged in quantitative work. In spite of its diminutive size, it must have involved a wide range of reading, no small exercise of criticism, and considerable skill and thought in arrangement and condensation. It shows Lupton at his best. It is a model of clear, restrained statement and rigorous logic, and should find a place in every physical and chemical laboratory.

At all periods of his life, Lupton was fond of travel, and his ample means made it easy for him to make extensive journeys. He was an acute observer and a shrewd judge of character, with a keen sense of humour—qualities which, added to his wide reading and knowledge of history and his readiness to communicate his knowledge, made him interesting as a companion.

He died at his London house, 102, Park Street, Grosvenor Square, on July 10th, 1918, and was buried at St. John's Cemetery, Roundhay. He showed his interest in the work of the Chemical Society by bequeathing to it his valuable chemical library.

T. E. THORPE.

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### GEORGE MARTINEAU, C.B.

BORN 1835; DIED FEBRUARY 5TH, 1919.

By the death of Mr. George Martineau, which occurred after a brief illness at his residence, Gomshall Lodge, Gomshall, Surrey, we have lost a member of an old and distinguished family and a man who was perhaps the greatest authority of his time in this country on sugar from its economic point of view. The deceased was the son of Mr. George Martineau, of Tulse Hill, and grandson of Mr. David Martineau, who in 1797 established the sugar refining firm which, as David Martineau and Sons, was at one time the largest in London; it has remained in the family for more than a

century. The fact is not without interest to our Fellows that this firm was one of the first, probably the first, in this country to recognise the value of scientific control, and the partners appointed the late Mr. C. Haughton Gill, F.C.S., first as their chemist and subsequently as their manager.

Mr. Martineau was educated at University College, London, and on coming of age entered his father's business, in which he was actively associated until his retirement in 1896. His connexion with sugar refining was on the commercial side, but he always took a keen interest in the general technology of the industry. Although a Liberal of the Gladstonian school, he recognised the defects of our fiscal system more than forty years ago; and in 1872, when the effects of the foreign sugar bounties began to make themselves felt, the British refiners appointed a Committee with Mr. Martineau as Secretary. This Committee visited the principal beet-growing countries of Europe. Thus commenced the anti-bounty campaign, which culminated in the abolition of the bounties by the International Convention of 1902. In recognition of his services, Mr. Martineau was appointed a Companion of the Bath by King Edward VII.

Imbued with the true scientific spirit, Mr. Martineau possessed a thoroughly logical mind, clearly shown by his numerous writings, which were continued up to the last days of his life: it may be said, indeed, that he died in harness. He was a chemist by instinct, and few commercial men had a greater appreciation of chemistry and chemical research. Keeping himself *au courant* with all the chief events in the progress of our branch of science, it was doubtless with this object that he became a Fellow of the Chemical Society in 1871. It cannot be forgotten that, equally with those members of his firm connected with the practical side of sugar refining, he shared a strong belief in the precise methods which chemical analysis affords when applied to commercial questions. In this connexion, we may point out that he was a pioneer in the establishment of the Beetroot Sugar Association of London, the functions of which were to check the weights and make analyses of the whole of the raw beetroot sugar shipped from the Continent to the Port of London.

Mr. Martineau's memory will be cherished by many. His charming personality, gifted conversational powers, wide erudition, and his deep sincerity had secured for him a wide circle of friends. Not a few have reason to be grateful to him for the assistance and encouragement he gave them at the commencement of their careers; but from these he resented open thanks, being quite content to view their progress with silent satisfaction.

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ARTHUR R. LING.

## SIR ALEXANDER PEDLER, F.R.S.

BORN MAY 21ST, 1849; DIED MAY 13TH, 1918.

LIKE many other chemists who have attained an eminent position in the scientific world, Pedler began life in connexion with pharmacy. His father, Mr. George Stanbury Pedler, was in business as a pharmacist at 199, Fleet Street until, on the removal of old Temple Bar and the widening of Fleet Street, preparatory to the erection of the Law Courts, the premises were swept away.

Pedler received his early education in the City of London School, which he left at midsummer, 1865. In October of the following year, at the age of seventeen, he won a Bell Scholarship, and began work as a student in the laboratory of the Pharmaceutical Society in Bloomsbury Square. Here he went through the usual course of analytical work, and at the end of the session he was awarded a certificate of honour in practical chemistry. Before leaving, he began a piece of research suggested to him by the present writer, who was at that time Demonstrator in the laboratory. It was with great regret that he parted with the promising young student, who by this time had decided to leave the comparatively narrow field of pharmacy and proceeded to place himself under Professor (afterwards Sir Edward) Frankland, at the Royal College of Chemistry, then in Oxford Street. There, after carrying on his studies for two years further, he assisted Frankland in the separation of the amyl alcohols of fousel oil by Pasteur's process. This work was done in the laboratory of the Royal Institution, where Frankland had held the Professorship of Chemistry in succession to Faraday since 1863. From the optically active and inactive alcohols, Pedler prepared the corresponding valeric acids, and gave an account of his work to the Chemical Society in 1868 (*Journ. Chem. Soc.*, **21**, 74). Further work in this direction was interrupted by his taking part in the solar eclipse expedition to Sicily in that year.

From 1871 Pedler served for two years as lecture demonstrator to Sir Edward Frankland in the Royal College of Chemistry in succession to Mr. Herbert McLeod, who had been appointed to the professorship of chemistry in the then newly instituted Royal Engineering College at Cooper's Hill. At the same time, he assisted in the research work on gaseous spectra in which Frankland and Lockyer were jointly occupied. This naturally directed Pedler's attention to the fascinating problems connected with the physical constitution of the sun and the stars. Consequently, on receiving



in 1873 appointment as professor of chemistry in the Presidency College, Calcutta, he naturally occupied himself with subjects connected with celestial chemistry, and soon after his arrival in India he was charged with special duty in connexion with the eclipse expedition of 1875.

On joining the Presidency College, he found that no practical work in any department of science was done by the students. To remedy this deficiency in the scheme of instruction was his first care, and ultimately he succeeded in securing the introduction of a small amount of practical work into the science course for the M.A. degree, and a practical examination was held for the first time in 1882. Ultimately, he had the satisfaction of finding the university regulations require every college sending up students to provide the necessary staff and appliances for teaching practically each of the departments of science, and each candidate for B.A. or B.Sc. degree to be examined practically.

Having been born in 1849, Pedler was still a very young man on reaching India, and those who knew him in his early days will gladly recall those features of his character which made him not only popular in youth, but, remaining unchanged to his latest years, contributed materially to his success in official life.

In India Pedler retained the professorship in Calcutta, together with the office of Meteorological Reporter to the Government of Bengal, for twenty-two years. He then became Principal of the Presidency College and Vice-Chancellor of the University. In 1899 he was appointed Minister of Public Instruction in Bengal, and became an additional Member of the Legislative Council under the Viceroy.

Among other institutions, Pedler took great interest in the Ravenshaw College at Cuttack, and was instrumental in obtaining accommodation for the physical and chemical departments in that institution. These successive steps in official life explain the fact that Pedler's original contributions to scientific chemical literature were limited to the one paper on valeric acids, already mentioned, and several which arose out of the circumstances of his residence in India.

Soon after his arrival in that country, he examined and reported on the coal-gas and water supplies of Calcutta. In 1878 he sent home a paper on the poison of the cobra, which was printed in the *Proceedings* of the Royal Society (27, 17).

In 1890 he contributed to the *Journal* of the Chemical Society three papers, which showed that he was utilising opportunities, previously neglected by chemists, of studying the action of tropical sunlight on chemical change. The first of these papers was entitled

“The Action of Light on Phosphorus and some of the Properties of Amorphous Phosphorus.” The second paper was on “The Action of Chlorine on Water in the Light, and the Action of Light on certain Chlorine Acids.” The third paper contained an account of attempts to estimate hydrogen sulphide and carbon bisulphide in gaseous mixtures by explosion with oxygen.

Pedler was a Fellow of the Institute of Chemistry and of the Chemical Society. He was elected F.R.S. in 1892. He was also an honorary member of the Pharmaceutical Society.

In recognition of his public services in India he was created C.I.E. in 1901, and on his return to England in 1906 he received the honour of knighthood. On his retirement he soon found occupation in public work; he became honorary secretary to the British Science Guild, which owes much to his devoted service, and on the outbreak of war he took up active duties connected with the research department of the Ministry of Munitions. Whilst attending a meeting of Committee at that office on Monday, May 13th, 1918, he was seized with sudden illness and expired immediately. His death came as a great shock and surprise to his many friends, among whom no suspicion of weakness had been entertained.

Pedler was twice married, first in 1878 to Elizabeth Margaret, daughter of C. K. Schmidt, of Frankfurt, and, secondly, to Mabel, youngest daughter of the late Mr. W. Warburton, R.N., of Dedham, who survives him. He left no children. W. A. T.

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#### JOSEPH PRICE REMINGTON.

BORN MARCH 26TH, 1847; DIED JANUARY 1ST, 1918.

JOSEPH PRICE REMINGTON was born at Philadelphia on March 26th, 1847, and belonged to a well-known Quaker family, his ancestors having been for three generations members of the Society of Friends. His father, Dr. Isaac Remington, was a prominent Philadelphia physician, whilst his mother, the daughter of John Hart, was in a direct line of descent from an apothecary who practised his art in Philadelphia early in the eighteenth century. An inclination for the professional pursuit of pharmacy, which was manifested by Remington at an early age, would thus seem to have been inherited.

At the comparatively early age of fifteen years, Remington

suffered the loss by death of his father, and this appears to have affected his subsequent career; for a plan to supplement his preliminary education—obtained in private schools and in the high school at Philadelphia—by an academic course of study had to be abandoned. In 1863 he entered the establishment of Charles Ellis, Son and Co., a firm of wholesale druggists in Philadelphia, where he remained for four years, and during that time he attended evening lectures at the Philadelphia College of Pharmacy, from which he graduated in 1866. During the years from 1867 to 1870 Remington was employed in the manufacturing laboratories of Dr. E. R. Squibb, at Brooklyn, N.Y., and in this position he had exceptional opportunities for acquiring a knowledge of technical methods, especially in their application to chemical and pharmaceutical products, whilst also enjoying intimate association with a man who was widely known for his scientific attainments and exceedingly high ethical standards. Remington then returned to Philadelphia, and after a short period of service with the firm of Powers and Weightman, manufacturing chemists of that city, he established a pharmaceutical business on his own account, which was successfully conducted for thirteen years. In the meantime, he had also served as an assistant to Professor Parrish, and subsequently to Professor Procter, at the Philadelphia College of Pharmacy, and on the decease of the latter, in 1874, he was elected to the professorship of pharmacy in the college which had been his *alma mater*. The position which Mr. Remington was thus called on to fill he retained for the exceptionally long period of forty-four years, or until the close of his life, and during that time several thousand students had received instruction from him.

As circumstances did not permit Professor Remington to acquire a scientific training, in the modern sense, his attainments and talents were directed more to what may be termed the practical side of pharmacy and to editorial work. As examples of this activity, there may specially be noted his participation in several revisions of the "United States Dispensatory," the publication of his well-known text-book, entitled the "Practice of Pharmacy," and the arduous duties committed to him as Chairman of the Committee of Revision of the "United States Pharmacopœia."

Professor Remington was a Fellow of the Chemical, Linnean, and Royal Microscopical Societies of London, as well as an active member of several scientific societies in his own land. The esteem in which he was held by his professional colleagues had, moreover, been manifested by the bestowal of honorary membership in a large number of pharmaceutical organisations both at home and abroad. He had travelled widely in his own country, and had

several times visited Europe, the last occasion having been in the autumn of 1913, which will still be pleasantly remembered by many of his English friends.

The home life of Professor Remington, with a devoted wife and several children, was particularly happy. His genial nature and fluency as a speaker, together with the fund of interesting information which he possessed, rendered him a most pleasant companion. In social as well as professional circles he was therefore always gladly seen, and accorded a prominent place.

The writer of these lines is grateful for the privilege of rendering a slight tribute to the memory of one with whom a friendship had been sustained for more than forty years, and whose qualities of mind and heart had won such extended appreciation and regard.

F. B. POWER.

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### JEAN JACQUES THÉOPHILE SCHLOESING.

BORN JULY 9TH, 1824; DIED FEBRUARY 8TH, 1919.

ONE of the oldest and most distinguished of the foreign members of the Society, Jean Jacques Théophile Schloesing, passed away on February 8th of this year. He was in his ninety-fifth year, and almost all his life had been associated with agricultural chemistry. He knew its illustrious founders, Boussingault, Lawes, and Gilbert, when they were still young men almost at the beginning of their careers; he introduced new ideas at a critical stage, and, finally, when development had temporarily ceased, he opened up a new path, which is still leading to fruitful results.

Schloesing was born at Marseilles on July 9th, 1824. At the age of seventeen he entered the Polytechnic School, and left it two years later to take a post in the "Service des Manufacteurs d'Etat." He thus began his career at the most eventful period in the history of agricultural chemistry; it was the year, 1843, in which Lawes and Gilbert started their great work at Rothamsted, one year after Liebig's famous report on agricultural chemistry to the British Association, and four years after Boussingault had commenced his striking investigations at Bechelbronn.

He must have done well in his first post, for three years afterwards—in 1846—he became Director of the *École des Tabacs*, and within a few months published his first paper in the *Comptes rendus*; it was on nicotine and its estimation in leaf and manu-

factured tobacco. He was the first to obtain nicotine in any quantity; it had previously been prepared, as he tells us, only in "quelques rares échantillons." Schloesing verified its composition and designed a method for estimating it within about 1 per cent.—a very accurate determination for the time. The method consisted in displacing the nicotine with ammonia, extracting with ether, eliminating the excess of ammonia by the evaporation of the ether, and then titrating the residual base with sulphuric acid. For five years no further publications appeared, then followed an ingenious paper on the determination of ammonia in tobacco; milk of lime was added, and the mixture placed over sulphuric acid in the cold. The ammonia volatilised, and was absorbed by the acid, but at the low temperature of the experiment no decomposition of other substances occurred. This paper was followed shortly afterwards by one on the estimation of nitrates in presence of organic matter; hydrochloric acid and a ferrous salt were added, and nitric oxide produced; this was washed free from hydrochloric acid, then mixed with air or oxygen, converted into nitric acid, and titrated with an alkali. Subsequently, however, Schloesing found that conversion into nitric acid was unnecessary, and he designed a method for direct measurement of the nitric oxide. He also introduced considerable improvements into the methods for estimating ammonia in dilute liquids, such as rain. As an illustration of the very cumbersome nature of some of the methods then in vogue, it may be mentioned that the determination of ammonia in rain-water at Rothamsted, carried out in 1853, had involved the distillation of 2 cwt. of rain and evaporation of the distillate with sulphuric acid; in spite of all the laborious care bestowed on the work, the figure obtained was probably double the true value.

For the next seven years Schloesing published no scientific work, but from 1860 onwards he issued a number of important publications. In 1860, also, he began some cultural experiments with tobacco, which lasted for fifteen years, and were designed to ascertain whether the physical properties and nicotine content of the leaf are characteristic of the variety or the result of environmental factors. In the first series, tobacco was raised from samples of seed coming from various regions; the resulting leaf had in each case the physical characters and nicotine content characteristic of the parent plants grown in their original home. The second series was more extended and lasted fourteen years; its purpose was to discover whether any marked alteration occurred in the characteristic properties when a variety is cultivated in a new district. Havanna tobacco was grown, and the seed saved; some was sown and some was stored; each year a certain quantity of the seed of

each generation was sown. In no case was any difference observed.

In 1866 Schloesing began his investigations on the soil. It was probably in this subject more than in any other that the genius of the man shone out. Looking back at these papers, their striking feature is their modernness; one can well believe that at the time of publication they would not be fully appreciated. Again and again he broached new subjects, which neither he nor his contemporaries developed, but which later workers rediscovered thirty or forty years afterwards and showed to be of signal importance. He was essentially a pioneer rather than a builder, and he had the extraordinarily good fortune to discover gold almost every time; but he never himself developed his "finds," and the subject was not sufficiently well organised to ensure that others should develop them for him.

Schloesing's period of greatest activity was from 1866 to 1879, when he was between forty-two and fifty-five years of age; during this time he opened up no fewer than five new fields of soil investigation, three of which are now proving extremely valuable. His first soil paper was on the soil solution, which he separated from the solid particles by a displacement method. The subject received very little attention for nearly forty years; its importance was not fully realised until Whitney and Cameron in America published their striking paper in 1903, when investigations began again, using at first methods similar to those that Schloesing had designed. At the present time it receives perhaps more attention than any branch of soil chemistry.

Another subject which has come into prominence in recent times was investigated by him in 1868. He showed that nitrates are decomposed during certain fermentations, and five years later he further showed that they are reducible to gaseous nitrogen in soils deprived of oxygen. He also demonstrated that oxidations rather than reductions are the normal phenomena in soils under natural conditions; surface soils readily absorb oxygen, whilst sub-soils do not. After a lapse of nearly thirty years this phenomenon was independently rediscovered, and its investigation figures prominently in some of the most recent research programmes.

His most important work, however, was on nitrification. For a long time it had been known that nitrates are gradually formed when plant or animal residues, farmyard manure, etc., are incorporated in the soil. The process was of much technical importance in the seventeenth and eighteenth centuries as the source of nitrates for gunpowder. During the Thirty Years' War and other great continental wars, the various governments had been seriously

concerned in these so-called nitre beds, and had done a great deal to stimulate their development. An interesting collection of memoirs relating to the practical details was published in Paris in 1776.\* A study of these papers shows that the conditions of the change were tolerably well ascertained even then, but nothing was known of its mechanism.

It has several times happened in the history of civilisation that agriculture has benefited by knowledge gained during war. The mass of information accumulated during the eighteenth century wars, and apparently rendered useless in the nineteenth century by the promise of peace and the discovery of nitrates in Chile, was found to be of fundamental importance in agriculture. Boussingault had realised, and Schloesing at once accepted the view, that the nutrition of plants, so far as nitrogen was concerned, depended on the nitre-bed processes; organic nitrogen compounds, useless as plant nutrients, became converted into highly valuable nitrates when added to the soil; the more rapidly this change could be brought about, the better for the plant. So long, however, as the mechanism of the change was unknown, the old knowledge was simply empirical and incapable of full utilisation. Many investigations had been made, but the problem remained unsolved. The balance of opinion was in favour of a purely physical process, but there was also a strongly supported chemical hypothesis.

In 1875 a Commission was appointed to inquire into a scheme for carrying Paris sewage out to the land between Clichy and the forest of St. Germain, and Schloesing was asked to draw up the report. Rarely, even in France, can an essentially practical inquiry have led to such striking scientific results. When Schloesing had finished the investigation, he had not only discovered a new and vastly improved method of treating sewage, but he had realised what was the cause of nitrification, and thus founded the science of soil bacteriology. We cannot do better than let him tell the story in his own words:

“I was selected,” he tells us, “to draw up the report of this Commission. On this occasion, following the plan indicated in 1856 by M. Hervé Mangon, and taking advantage also of the more recent investigations of Dr. Frankland, I endeavoured to elucidate the principles involved in the land treatment of sewage by connecting the process with the phenomena of slow combustion of organic matter in an atmosphere containing oxygen; I investigated at the same time the conditions necessary to secure satisfactory

\* “Receuil de Mémoires et d’Observations sur la formation et sur la fabrication du Salpêtre par les Commissionnaires nommés par l’Académie pour le jugement du Prix du Salpêtre.”—Paris, 1776.



purification in practice. I made a special point of distinguishing two problems which were often confused: purification simply and solely of Paris sewage, which would only require an area of 2000 hectares (5000 acres), and agricultural utilisation of Paris sewage, which would require an area twenty times as great.

“Boussingault had just published the researches on nitrification that he had carried out some time previously. Blood, meat, wool, straw, and oil-cake did not nitrify when mixed with sand and chalk and allowed slowly to oxidise; but they rapidly nitrified when mixed with soil. I had vainly tried to nitrify ammonia by adding it to sand and chalk and leaving the mixture exposed to air. These results led me to think that the property of bringing about nitrification was peculiar to soil.

“Wishing to fix my ideas on the subject, I made the following experiment. A large tube, 1 metre long, was filled with 5 kg. of ignited sand mixed with 100 grams of powdered chalk. The sand was watered daily with sewage, the amount being so arranged that it took eight days to traverse the tube. For the first twenty days there was no sign of nitrification, then nitrates began to appear, and the amount rapidly increased; finally, the liquid flowing out of the tube contained neither ammonia nor organic matter—the sewage was absolutely purified.”

The quality of the man's genius was revealed in two striking deductions drawn from this simple experiment. One was of supreme practical importance, and has revolutionised sewage disposal practice.

“Au point de vue de l'épuration des eaux d'égout, l'expérience . . . prouve, en effet, qu'il n'est nullement nécessaire que l'irrigation soit établie sur les terrains agricoles; de sables stériles se prêtent parfaitement à l'épuration, lorsque le ferment nitrique, apporté par les eaux mêmes, a pris possession du milieu.”

From this to the modern bacteria bed is no great step, at any rate in principle.

The second deduction was of even greater consequence for the development of agricultural science. Reverting to the delay of twenty days in the setting in of nitrification, Schloesing and Muntz asked why it set in. With characteristic shrewdness they observed that this delay could scarcely arise if the process were purely physical or chemical; some biological factor seemed to be indicated. In order to test this possibility they added a little chloroform to the sewage; nitrification at once stopped. They then removed the chloroform and “seeded” with a little fresh sewage; after an interval nitrification began again. This showed that the process was brought about by living organisms, and forthwith Schloesing

and Muntz announced the existence of a living ferment. The discovery at once attracted attention; Warington at Rothamsted immediately recognised its importance, and proceeded to investigate nitrification in the Rothamsted soils; he was able to confirm the accuracy of Schloesing's deductions. Later on, the proof was made more rigid by Winogradsky's discovery of the organism. It is no diminution of the credit of the discovery that Pasteur in 1862 had already foreshadowed it, as Schloesing himself pointed out, in his remarkable statement:

“Beaucoup d'êtres inférieurs ont la propriété de transporter l'oxygène de l'air, en quantité considérable, sur les matières organiques complexes: c'est un des moyens donc se sert la nature pour transformer en eau, acide carbonique, oxyde de carbon, azote, acide nitrique, ammoniacque, les éléments des substances organiques élaborées sur l'influence de la vie.”

This research marks the beginning of soil bacteriology. It seized the imagination of the younger workers, and speedily attracted recruits to the new subject. Although Schloesing did not himself develop the subject, he was satisfied that the “ferment nitrique” did not exhaust the list of soil organisms. Reverting to his earlier work on the absorption of oxygen by soils, he says in one of his lectures\*: “C'était là, pensait-on alors, un fait purement chimique. On sait aujourd'hui que c'est principalement un fait biologique, c'est-à-dire que la combustion observée est le résultat de la vie de nombreux organismes, tel par exemple que le ferment nitrique, lequel est chargé de transporter l'oxygène sur l'azote.”

These investigations by no means represent the whole of his work on soil, although they may well prove to be his most permanent contributions to science.

By a lengthy washing process, he obtained a preparation of the finest clay particles which remained indefinitely suspended in pure water, but was precipitated by traces of a calcium or magnesium salt. This was commonly regarded as being in some sense the essential clay, and agricultural chemists marvelled at the minute amount present even in heavy soils. The conception served a useful purpose, but it has since been replaced by a broader one: the soil is now considered to be made up of particles varying from 1 mm. downwards to molecular dimensions, the different groups merging one into another without perceptible breaks. The clay group is assigned for convenience an upper limit of 0.002 mm., but this is regarded as purely conventional.

Another important investigation had to do with the movements of calcium carbonate in the soil. The conditions of solubility of

\* “Leçons de chimie agricole,” 1883.

calcium carbonate in carbonic acid were determined, and the relationship between the quantities of these two substances was shown to follow a logarithmic law. Deductions were drawn which threw important light on the practice of liming and marling, and on the presence of lime in natural waters.

During the course of these investigations, Schloesing was appointed in 1876 to the Chair of Agricultural Chemistry in the Institut Agronomique, then just founded. Eleven years later, in 1887, he followed the illustrious Boussingault at the Conservatoire des Arts et Metières. During his active period, his lectures were collected by his son in a volume, which still remains a source of inspiration to the student.

In 1875 he began another important group of investigations: he carried out a series of determinations of the amount of ammonia in the air, and published some interesting speculations as to its source. He supposed that a great natural circulation took place; the nitrates washed out from the soil find their way to streams and rivers, and finally to the sea; there they are reduced to ammonia, some of which escapes into the atmosphere, is blown over the land, and there absorbed by the soil or washed down by the rain. The ammonia then nitrifies, and such of the resulting nitrate as is washed out from the soil by rain-water passes once more through the same cycle.

In like manner, he supposed a circulation of carbon dioxide between oceans and atmosphere, and in this way he explained the smallness of the variations in amount of the carbon dioxide in the air from time to time. He considered that the proportion of carbon dioxide in the air was probably diminishing, although, of course, very slowly. "What," he asked, "will be the result?"

"Cet appauvrissement continue-t-il encore, et, s'il en est ainsi, ira-t-il jusqu'au point où il causerait la ruine de la végétation et par suite la fin de toute vie à la surface de la terre? La solution de cet problème d'un si haut intérêt nous échappe absolument. Elle ne pourra être donnée que par les générations qui viendront longtemps après nous."

Well may we envy a man and a generation that had nothing worse to worry about!

E. J. RUSSELL.

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## ALFRED SENIER.

BORN JANUARY 24TH, 1853; DIED JUNE 29TH, 1918.

## I.

ALFRED SENIER was born on January 24th, 1853, at Burnley, in Lancashire. His father, who had been one of the early settlers in Dover, Wisconsin, had returned to England some six years previously to engage in business as a pharmacist, but for reasons of health he found it necessary to return to America shortly after the birth of Alfred, his eldest son. Thus except for a brief visit to England during infancy and another during his student days, Senier's whole youth up to the time of his graduation as M.D. at the University of Michigan in 1874 was spent in the United States, chiefly at Mazomanie. Mr. Alfred Senier, the father, appears to have been a man of romantic disposition, which found its expression in a certain restlessness, leading him in early life to spend several years at sea and later to travel considerably in Europe. The son inherited this taste for travel, and was allowed to visit both London and Paris at the age of eighteen in the middle of his student career.

Immediately after his graduation the family finally returned to London, where Senier obtained a post at the school of the Pharmaceutical Society, first as assistant to Prof. Atfield and later as demonstrator. He was elected a Fellow of the Chemical Society in 1875 and a Fellow of the Institute of Chemistry three years later.

In 1881 he left the school of the Pharmaceutical Society in order to take charge of the chemistry teaching at St. John's College, Battersea, where he remained for three years.

During this period in London his interests extended beyond his professional duties, which hitherto did not seem to offer him sufficient scope for his mental activities. Endowed as he was with the faculty of accurate reasoning, and with clearness and breadth of mental vision, his interest at this time turned markedly to philosophical questions. We find him appointed as honorary secretary and treasurer of the Aristotelian Society on April 19th, 1880, when it was first organised. He acted in this capacity until 1884, and in 1902 he was elected an honorary life member. At its fifth meeting he delivered a lecture to the Society on "Plato." In 1882 we find him delivering a series of lectures on the "Elements and Early History of Terrestrial Physics" to the Positivist Society in Newton Hall, Fetter Lane. It is also interesting to observe that he wrote to the *Pharmaceutical Journal* in 1877 a spirited letter in

support of the proposal to admit lady pharmacists into the Pharmaceutical Society.

In 1884 he left London for Berlin, where he studied chemistry under A. W. von Hofmann. It was at this period of his life that he received his greatest inspiration. Enthusiastic and imaginative by nature, he threw himself wholeheartedly into his work, and soon attracted the attention of Hofmann, who became his ideal as a professor, lecturer, and teacher. A close friendship bound him to his old master, in whose family circle he spent many happy evenings, and whose personality made a lasting impression on his mind.

Later in life when fulfilling his duties in an academic chair he loved to think that the same happy relations existed between his students and himself as he had felt when a student of Hofmann. His interest in his past students never flagged. He was ever ready to help them, and always pleased to hear of their success.

Senier's own exceptional powers as a teacher were no doubt due to a large extent to the powerful influence of Hofmann, of whom he was never tired of speaking. Among his papers this idea is expressed in words thus: "I had special opportunities for studying the methods of teaching for which Hofmann was justly famous. He possessed that rare gift of inspiring his students with the discoverer's enthusiasm. We discovered, with him to lead us, things known to science; and then, without realising a difference, we followed him to things that were new, and thus became chemists with the habit of research. With such a leader in research, with such a teacher in the right meaning of the word, no wonder that those who came within his influence became inquirers and teachers too."

On June 25th, 1887, he graduated Ph.D. in Berlin, and returned shortly afterwards to London.

Here he remained for a few years writing articles for the standard dictionaries of chemistry until he was called to act as locum tenens for Maxwell Simpson, Professor of Chemistry at Queen's College, Cork, in 1890. The latter resigned the following year, and was succeeded by Prof. A. E. Dixon, of Galway. The vacancy thus created was filled by the appointment of Senier to the Chair of Chemistry at Galway, which he occupied until his death.

This Chair when first established in 1849 was filled by Edmund Ronalds, who in the early days of the Chemical Society served as Secretary and also acted as Editor of this Journal.

In addition to fulfilling the duties as Professor of Chemistry at Queen's College, Galway, Senier acted as Lecturer in Medical Jurisprudence and Hygiene.

In Galway his professorial duties, his work on the College Couu-

cil, and his personal interest in his students engaged his closest attention. His strong personality and buoyant enthusiasm made a powerful appeal to the minds of his students, with whom he was always immensely popular. He was a champion of students' interests, and never tired of reminding them that he was, and would remain, "always a student." Although not naturally attracted to athletic sports, he quickly realised their healthy influence and value in promoting *esprit de corps* and harmony among young men, assembled from all parts of Ireland, from homes representing all shades of religious and political differences. They sought and obtained in Galway a University training under a system which, although technically non-residential, was by reason of the smallness and isolation of the "Citie of the Tribes" virtually residential. Senier seized his opportunity and quickly won the affection of all the students by becoming the active patron of their sports. He founded the athletic union and acted as its president and treasurer for seventeen years. The astonishing prowess of the football team in its competitions with the larger sister colleges of Belfast and Cork was in no small measure due to his sympathetic and generous support.

Meanwhile, the problem of continuing his researches had to be faced, and was tackled courageously and successfully. At first little progress could be made, as Galway offered but a poor field for creating and maintaining an advanced chemical atmosphere. Nevertheless, he persisted in his attempt, and soon acquired a good chemical library and equipment sufficient to make a start. Well-furnished modern laboratories soon followed, and in conjunction with various assistants, demonstrators, and senior students he was eventually able to contribute a large number of papers, chiefly on acridines and on phototropic and thermotropic compounds, to the *Transactions* of this Society.

In 1908 the Royal University of Ireland conferred on him the degree of D.Sc. *honoris causa*. This event was made the occasion of a public presentation to him of an address and silver casket from his old students, whose eager and liberal response, even from the most distant parts of the world, bore ample testimony to the lasting feeling of reverence and goodwill in which they held their old teacher and patron of their sports.

He was elected a member of the Royal Irish Academy, and in 1912 he acted as President of the Chemical Section of the British Association at the Dundee Meeting.

When the National University of Ireland was created in 1908 he took an active part in its organisation and development. He was

a member of the Senate until his death, which took place on June 29th, 1918, in Galway after a brief illness. Senier married in 1887, and is survived by his wife and two daughters.

W. S. M.

## II.

By the death of Alfred Senier the country has lost one of its most enthusiastic and devoted workers in the domain of organic chemistry. The loss is felt most keenly by all his students and co-workers, who will always cherish the remembrance of his sympathetic and inspiring personality. In him the spirit of scientific inquiry was strong indeed, for in the face of difficulties, which would have baffled and beaten many a man of less sterling worth, his courage never failed, but enabled him to pursue unwearingly the lofty ideals which he had formed in his youth and to achieve a measure of success and distinction which will assuredly become fruitful in the future.

Even before leaving America he had shown evidence of a desire to undertake original investigations, his first paper, on the analysis of soap, appearing in the *American Journal of Pharmacy* in 1874. At the School of the Pharmaceutical Society his aspirations received encouragement from Prof. Attfield, and he contributed a series of articles to the *Pharmaceutical Journal*, chiefly relating to the investigation of pharmaceutical preparations and including a table for the qualitative analysis of scale preparations, alkaloids, etc. The interaction of glycerol and borax particularly engaged his attention, because he found that he could utilise it as a means for detecting glycerol. In 1878 he contributed to the *Transactions* of the Chemical Society "A New Test for Glycerin." He also published a number of articles in the *Sanitary Engineer*.

In Berlin Senier came under the powerful influence of A. W. von Hofmann. The enthusiasm which Hofmann aroused in him remained with him to the end, and he spoke of him almost with veneration in his public lectures.

Inspired as he was by his experience in Germany, the whole course of Senier's later life afforded abundant evidence that he had learned nothing of the modern German aggressive spirit of world-domination. Indeed, his realisation of its existence only came to him after war was declared, and its effect on him was painful in the extreme, as shown in his letters to the writer.

In Berlin his attention was first directed to the action of heat on the formyl and thioformyl derivatives of aromatic amines, and later to the investigation of cyanuric acid and cyanuric chloride. He was



able to show that the alleged  $\alpha$ - and  $\beta$ -isomerides obtained by Herzig by the interaction of carbamide and hexabromoacetone were in reality identical with ordinary cyanuric acid. This work was embodied in his dissertation for the degree of Ph.D.

Shortly after his appointment to Galway he reverted to the examination of cyanuric acid, and found that the white solid produced by the polymerisation at  $0^{\circ}$  of freshly distilled cyanic acid was not pure cyamelide as was supposed, but consisted chiefly of cyanuric acid mixed with 30 per cent. of cyamelide.

Being greatly interested in all Hofmann's work, he decided to follow up the reaction by which ethylenediamines and piperazines are formed from arylamines. By using methylene dihaloids instead of ethylene dihaloids, he found that although the simplest arylamines give rise to methylenediamines, as the molecules increase in complexity through the inclusion of methyl groups or of condensed rings, the character of the reaction changes and results in the formation of acridines. Thus from  $\psi$ -cumidine he obtained hexamethylacridine, and from  $\alpha$ -naphthylamine a new dinaphthacridine. This result led him to study the subject of acridines in some detail, and a series of papers appeared in the *Transactions*. He also introduced a new and convenient system of notation in the acridine series. This work was followed by a paper on quinazolines and a series of papers on the synthesis of phototropic compounds, to which he was led by his observations on salicylidene-*m*-toluidine during the course of his investigations on acridines. This discovery of phototropic change led him to prepare and examine a large number of similarly constituted anils, many of which were also phototropic, although the property was by no means characteristic of the class. The change from the paler variety to the darker under the influence of sunlight occurs rapidly in a few minutes—whereas the reverse change requires a much longer time. This process of reversal can, he found, be accelerated by raising the temperatures, but there appears to be for each substance a critical temperature above which the property of phototropic change disappears. In some cases this temperature is near the melting point; in others it is much lower; in fact, in the case of two compounds examined, namely, salicylidene-*p*-anisidine and 2-hydroxy-3-methoxybenzylidene-*p*-xylylidine, no phototropic change is observed until a temperature of  $-20^{\circ}$  is reached. Similar colour changes were observed to take place under the influence of heat instead of light, this phenomenon being termed *thermotropy* by Senier. Thermotropy appears to be much commoner than phototropy, and in many instances the thermotropes were also found to be phototropic. The suggestion was put forward by Senier that these phototropic and thermotropic

changes are to be ascribed to isomeric changes affecting the aggregation of molecules in solids rather than to changes in the structures of the molecules themselves. In his Presidential address to Section B of the Dundee meeting of the British Association in 1912 he developed this idea of the existence of solid molecular aggregates. Several instances of polymorphic changes due to trituration were also examined, chiefly in the case of *p*-hydroxybenzylidenearylamines. This work, extending over several years, was the subject of a series of papers in the *Transactions*, and remains unfinished. No doubt it will be possible in the future to throw more light on the subject by means of optical measurements.

Apart from his purely scientific studies, Senier took a deep interest in educational affairs. The difficulties which had to be encountered in Galway were due partly to the remoteness of the College from the main centre of scientific activity and partly to the anomalous character of the College during the greater part of Senier's life in Galway.

Since the dissolution of the Queen's University in 1879 the three Colleges at Belfast, Galway, and Cork had been reduced from the status of integral members of a university to that of colleges where students were able to study for the examinations of an external institution—the Royal University. In addition to this loss of prestige, the College at Galway suffered through lack of active support by the people of Connaught. It was therefore not in close sympathy with its environment. This state of affairs has happily been remedied by the abolition of the Royal University and the creation in 1908 of two new teaching universities, namely, the National University of Ireland and the Queen's University of Belfast. The College at Galway, re-named "University College, Galway," became a constituent part of the National University, and Senier was elected to a seat on the Senate. The existence of the College has often been threatened, but it has survived and, indeed, attained a flourishing condition. There is no doubt that Senier's efforts to foster the spirit of scientific research materially advanced the cause of education in Galway and in Ireland. In his public lectures on "A Visit to Giessen; or Thoughts on Liebig and Chemistry in Germany" and "Bonn on the Rhine; Pages from its History and Stray Thoughts on Education" he deals in a very attractive way with the history of the development of scientific research in Germany, and in his lecture before the Royal Dublin Society in 1910 on "The University and Technical Training" he made a very lucid and careful analysis of the various university systems in the world. In view of modern needs these essays\* are

\* Published at Dublin, 1910, by Edward Ponsonby, 116, Grafton Street.

well worth reading, for he explains very clearly how industrial development does not depend on the technical education of the operatives, but arises naturally from the development of the highest form of scientific activity at the universities.

P. C. AUSTIN.

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### JOHN BISHOP TINGLE.

BORN 1867; DIED AUGUST 5TH, 1918.

JOHN BISHOP TINGLE, Professor of Chemistry in McMaster University, Toronto, who died on August 5th, 1918, at the age of fifty-one, after a brief illness, received his early training at the Royal Grammar School, Sheffield, entering Owen's College, Manchester, in 1884, under the late Sir Henry Roscoe. In 1887 he proceeded to the University of Munich to study with Claisen and von Baeyer, where he took the degree of Doctor of Philosophy in 1889. While at Munich his studies were essentially in organic chemistry, his dissertation for the degree dealing with the action of ethyl oxalate on aliphatic ketones.

On returning to England Dr. Tingle held certain junior appointments which offered him opportunities for research. Owing, however, to unforeseen family responsibilities he was compelled to give up, for a time, his chosen career of investigation, and taught chemistry in secondary schools.

In 1896 he came to America and was successively professor of chemistry at the Lewis Institute, Chicago (1897-1901), Illinois College, Jacksonville (1901-1904), and assistant in charge of organic chemistry at Johns Hopkins University under Professor Remsen (1904-1907). During his residence in the United States Dr. Tingle became sub-editor and abstractor in organic chemistry on the staff of the *American Chemical Journal*, his work being characterised with care and precision, and as his study of current literature in his chosen field was extensive and exhaustive he spared no pains to make his abstracts clear, complete, and useful. His long training as an abstractor on the staff of the *Journal of the Chemical Society* specially qualified him to take this important part in organising the organic abstracts for the American journal.

Dr. Tingle was appointed professor of chemistry at McMaster University, Toronto, in 1907, in which post he laboured energetically and faithfully until his death. It was perhaps in teaching, for which he possessed a special talent, that Dr. Tingle did his best

and most valuable work for the country of his adoption. He was insistent on the importance of careful, accurate, and clean craftsmanship, and held that theory was useless and often misleading without a knowledge of how it had been deduced and how it could be applied in practice. He laid special stress on the need of manipulative skill of the highest order as a necessary pre-requisite to orderly and clear reasoning and successful results.

Dr. Tingle's original work, embodied in upwards of thirty publications, deals with problems of organic chemistry, and is centred chiefly round the mechanism of the "Claisen reactions" and the products and mechanism of nitration in the benzene series. His last paper, which did not appear in print until after his death, settled certain minor points previously undetermined, and was intended to clear the way for a comprehensive study of the laws governing nitration and the means by which their reactions could be controlled. Dr. Tingle made organic research his life work, and carried through to a successful issue a large number of investigations in his chosen field. He held a first place among organic chemists in Canada, and had he been spared it was expected that he would have been able in a few years to devote himself almost exclusively to research. Much has been lost by his death.

In the sphere of Canadian war work Dr. Tingle was the first to recommend the intensive training of girls for employment in munition and chemical factories in Canada, and laid himself out energetically to instruct them towards this end. The extra work involved undoubtedly accelerated his death.

He translated and edited several important works in chemistry. For a long time "Spectrum Analysis," by Landauer and Tingle, was the most comprehensive work on the subject in English.

Dr. Tingle was a kind and generous man, taking a great personal interest in his students and their work and exciting their ambition and enthusiasm for advanced study.

He leaves a widow and two children.

W. R. L.

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