# OBITUARY NOTICES.

## JOHN YOUNG BUCHANAN *

BORN FEBRUARY 20TH, 1844; DIED OCTOBER 16TH, 1925.

JOHN YOUNG BUCHANAN was born in Glasgow on February 20th, 1844. He was the second son of Mr. John Buchanan of Dowanhill and the elder brother of the Right Hon. T. R. Buchanan, M.P., who represented Edinburgh in Parliament for many years. He was educated at the Glasgow High School and the University of Glasgow, where he graduated in Arts in 1863. His attention had been turned to Chemistry, and he proceeded to study this science on the Continent, spending several years in Germany at the Universities of Marburg, Bonn, and Leipzig, and going on in 1867 to Paris, where he worked in the laboratory of Würtz, a master for whose scientific genius and personal kindness he always cherished a warm admiration.

Shortly after his return to Scotland Buchanan was appointed Assistant to Professor Crum Brown, then recently established in the Chair of Chemistry in the University of Edinburgh, and in 1870, on Crum Brown's nomination, he was elected a Fellow of the Royal Society of Edinburgh.

When the voyage of H.M.S. *Challenger* was planned for the purpose of investigating the physical and biological conditions of the great ocean basins, it was decided that one representative of the physical sciences should be charged with all matters concerning physics, chemistry, and geology, except such hydrographical and meteorological observations as had been assigned to the naval officers. Buchanan was chosen for this comprehensive post by the Circumnavigation Committee of the Royal Society, who had prepared the programme of scientific work. His selection was due largely to his skill and resourcefulness in devising and making apparatus, his reputation as a practical chemist, his knowledge of mineralogy, and his interest in all natural phenomena. The wisdom of the choice was fully justified. Five years were entirely occupied by the *Challenger* work; the preparations for the cruise, and the fitting up of a chemical laboratory in the small space available on board, taking up several months before the ship sailed in December 1872, and the completion of work in hand occupying a longer time after the ship returned in June 1876.

Throughout those years Buchanan's mind was bent on the practical

* Reprinted by permission from the *Proceedings* of the Royal Society of Edinburgh.

problems arising in the study of sea-water; but he took full advantage of the many opportunities for excursions into little-known lands when the ship was in port, and he acquired a love of travel that never left him.

He returned to Edinburgh and set up a private laboratory, in which he carried on research on his own account. The possession of ample means made it unnecessary for him to seek any professional appointment, and he continued to spend much of his time at sea. He made investigations on the west coast of Scotland and on the lochs of the Great Glen in his steam yacht, the *Mallard*; and he took part in several voyages of the cable-laying ships of the Silvertown Company on the west coast of Africa and across the Atlantic, mastering the new methods of sounding by wire, which superseded the clumsy processes of the *Challenger*.

In Edinburgh he entered into the remarkable revival in the study of physical geography and kindred sciences which was a feature of the eighth decade of the nineteenth century, and he took a share in establishing the Ben Nevis Observatory, the Scottish Geographical Society, and the Scottish Marine Station. He contributed a large quantity of material for the equipment of the Physical and Chemical laboratory of the original Marine Station at Granton in 1884, and the writer of this notice had many opportunities there of profiting by his instruction in the arts of observing and recording. In 1887 the Royal Society of Edinburgh awarded the Keith Prize to Buchanan for his work in chemical oceanography, and in London the Royal Society elected him a Fellow.

Buchanan was on terms of friendship with Professor Robertson Smith, who encouraged him in the study of physical geography, and helped to persuade him to accept the lectureship in Geography in the University of Cambridge in 1889. Buchanan was given the Cambridge degree of M.A., and took rooms in Christ's College, where Robertson Smith was already established. He resigned the lectureship after holding it for four years, but Christ's College continued to be his home for twenty years, and in his will he left substantial proof of the regard he entertained for it. On leaving Cambridge, Buchanan took up house in London; but he was much abroad, frequently visiting South America, where he had property in the Argentine, and staying at continental resorts, where he had many friends, some of them in very high positions. Kindred tastes cemented a close friendship with Prince Albert I. of Monaco, and he spent much time as the Prince's guest on shore and afloat, making many cruises in the Mediterranean, the Atlantic, and to Spitsbergen in the Prince's yachts, which were splendidly equipped for oceanographical research.

The outbreak of war in 1914 was a blow from which Buchanan never recovered. He had been on terms of personal friendship with the Kaiser and other distinguished Germans, while his old scientific associations with France had been strengthened by his membership of the governing body of the Oceanographical Institute, founded by the Prince of Monaco in Paris. In real distress of mind, Buchanan gave up his London house and betook himself to Havana, in the West Indies, until hostilities ceased.

His last work was the preparation of three volumes, published by the Cambridge University Press, containing reprints of those of his papers which appeared to him the most worthy of preservation. To these he prefixed very copious analytical Tables of Contents, with comments and criticisms often of great interest. The volumes were: *Scientific Papers*, vol. i.—*Oceanographical*, published in 1913; *Comptes Rendus of Observation and Reasoning*, in 1917; and *Accounts Rendered of Work Done and Things Seen*, in 1919.

After his return to London in broken health, the isolating shadow of old age fell on him, and he withdrew more and more from the society of his remaining scientific friends. He died at the age of eighty-one, on October 16th, 1925.

Buchanan's scientific work was directed to the elucidation of practical problems presented to him during the voyage of the *Challenger*. He did not care for theoretical deductions or comprehensive generalisations. He seemed to work mainly for the satisfaction of his own mind, for once a definite result was obtained the problem lost its driving power; and only a portion of the notes which he amassed, with a care and precision that can only be described as meticulous, was ever worked up for publication. He used to say that he loved work but hated writing; still, the number of his published papers exceeds one hundred.

On the *Challenger* most of his time was filled by a routine prescribed by the Circumnavigation Committee, but the tedium was lightened by flashes of discovery. One was the fact of large concretionary deposits of manganese peroxide produced by chemical action of sea-water on minerals. Another was the discovery that the gelatinous substance found on all preserved deep-sea deposits, which Huxley had taken for a primeval organism and named *Bathybius Haeckeli*, was really a precipitate of calcium sulphate thrown down from sea-water by the addition of alcohol.

The short stay of the *Challenger* in Antarctic waters raised the question of the formation and melting of sea ice, on which Buchanan worked with great keenness for several years, producing a series of valuable papers on "Ice and Brines," in which he worked out the chemical and thermal changes accompanying the freezing of saline solutions and the temperature at which pure ice melted in them. This led to a further series of calorimetric researches on "Steam and Brines."

Another subject raised on the *Challenger* and settled in a shore laboratory, was the compressibility of glass and other substances under the pressure of the deep sea, ranging up to 5 or 6 tons per square inch. The apparatus invented for this purpose was handed over to Professor P. G. Tait, and used by him in determining the pressure corrections of the *Challenger* thermometers.

Buchanan's most important contribution to the *Challenger* Reports was a memoir on the "Salinity of Ocean Water," in which he published the first complete map of the world-wide distribution of surface salinity, the main features of which have been fully confirmed by later investigators.

His work on the Telegraph ships resulted in a study of continental slopes and oceanic shoals, which had scientific as well as practical value. One of his few general papers was a suggestive survey of Similarities in the Physical Geography of the Great Oceans, contributed to the Royal Geographical Society in 1886. In Limnology he was the first to prove that vertical circulation set up by the wind produced a winter temperature of the deep water in a lake far below the maximum density point.

The work of Buchanan was that of a pioneer breaking new ground, and it was his fate, which he recognised and perhaps resented, to make observations of fundamental importance, which were lost sight of under the superstructure raised by others whose names are better known to the scientific public. All he did was original work in the fullest sense. He owed nothing to other workers. He insisted always on going to the fountain-head, preferably by direct observation, for all data, and on handling such data in the way most likely to ascertain their true relationships even if that required difference from recognised authorities.

His character exhibited singular sincerity, and a kindliness which he did nothing to advertise. Although to acquaintances his manner may often have seemed cold and distant, his nature showed a very warm and friendly side to the few congenial comrades of his choice.

H. R. M.

---

## GIACOMO LUIGI CIAMICIAN.*

BORN AUGUST 27TH, 1857; DIED JANUARY 2ND, 1922.

GIACOMO LUIGI CIAMICIAN was the son of Giacomo Ciamician and Carolina Ghezzo and was born at Trieste, where his father's family,

* Translated by Sir Wm. J. Pope.

[*To face p.* **996.**]

of Armenian origin, had not been long established. The family claimed descent from the great 18th-century historian of the Armenian people, Michele Ciamician.

Ciamician received his secondary education in his native Trieste, where Prof. Augusto Vierthaler initiated him into chemistry; he then studied at the Polytechnic and the University of Vienna, devoting himself principally to Chemistry under Professors Barth and Weidel. While still a student he busied himself enthusiastically and with no little insight upon biological and physical investigations and published several papers of importance, thus laying the foundation of that broad appreciation of physical and biological science which became so evident in his later scientific work and which set the stamp of character on his future triumphs. In 1880 he became a Doctor in Philosophy in the University of Giessen and in the same year was appointed assistant under Stanislao Cannizzaro in the Institute of General Chemistry of the University of Rome. While in Rome, where he remained until 1887, he was appointed to a Readership, and in this capacity delivered, first, courses of lectures on spectroscopy and, later, on the nitrogenous organic compounds. In 1887 he was chosen in competition for the post of Professor of General Chemistry in the University of Padua, and in 1889, again competitively, he was elected into the corresponding chair in the University of Bologna; here he remained until his death, giving two courses, those of general and inorganic chemistry and of organic and biological chemistry.

The scientific work of Ciamician can be classified in six large groups :

### 1. *Various Chemical and Physical Investigations carried out between* 1877 *and* 1880.

This group comprises ten memoirs which deal particularly with spectrum analysis, and also with the resins and the composition of Dippel's oil; it treats of work done in the Polytechnic and the University of Vienna before its author proceeded to his Doctor's degree. The contributions to spectroscopy are of the greatest interest, presenting as they do a comparative study of the spectra of homologous elements which belong to the same group in the periodic system. Ciamician foresaw much that has been since firmly established by more modern methods; he affirmed the spectroscope to be the instrument destined to elicit information concerning atomic motion, and declared that analogous elements of the natural system have analogous structures. These conclusions were far in advance of their time, and it is small wonder that even Mendeléev and Wm. Ostwald judged them as fanciful.

2. *The Study of Pyrrole and Allied Compounds.*

This group includes about eighty papers published between 1880 and 1905; therein are described many derivatives of pyrrole with the details which establish the chemical character and behaviour of this base. The aromatic nature of pyrrole and its analogies with the phenols are here developed; these are questions of prime importance in connexion with this group of compounds and later became fundamental to the study of chlorophyll and hæmatin. The reduction products of pyrrole, pyrrolylene, and more especially of pyrrolidine, prepared for the first time in 1885, call for particular mention in that these groupings form part of the nuclei of such important alkaloids as hygrine, nicotine, cocaine and atropine, and of the proteins.

The results of these investigations were collected in a monograph "Il Pirrolo e i suoi Derivati," published in 1888, which gained for its author the Royal Prize of the Accademia dei Lincei. Ciamician gave a masterly review of the whole subject in an address to the Deutschen Chemischen Gesellschaft "On the Development of the Chemistry of Pyrrole during the last Quarter of a Century," in 1904 (*Ber.*, 1904, **37**, 4200). Amongst the work done in this field should be noted the discovery and utilisation of tetraiodopyrrole or *iodol*, which has found considerable therapeutic use as a substitute for iodoform. To be remarked also is the preparation from pyrrolidine of butadiene, a hydrocarbon which later became so important in connexion with the synthetic manufacture of indiarubber. Meyer and Jacobsen ("Lehrbuch der organischen Chemie," 1920, **2**, 147) refer to this group of investigations in their statement—"Das eigenartige Verhalten der Pyrrol-Körper wurde besonders durch eine grosse Reihe von trefflichen Untersuchungen beleuchtet, welche man dem italienischen Forscher Ciamician und seinen Schülern verdankt."

3. *Researches on Certain Vegetable Components.*

Thirty-seven papers are devoted to this subject and appeared between 1888 and 1899. The constitutions of a number of organic compounds of vegetable origin were established by these investigations. The work on apiole, and the conversion of safrole and eugenol into their isomerides, which was vital to the industrial manufacture of heliotropin and vanillin, here call for mention; so also does the study of the components of the Coto and similar barks, of pseudopelletierine and the constituents of the essential oil of celery, in which the constitution of the aromatic principle, sedanolid, was elucidated. This was one of Ciamician's finest pieces of work; it preceded that of Willstätter, who developed with such success, and in a variety of directions, the line of investigation so well marked out and defined by Ciamician.

### 4. *Researches on the Chemical Action of Light.*

Forty notes and nine memoirs were published between 1900 and 1915 on this subject, which was developed into the first systematic study of the behaviour of organic substances towards light.

These researches on the action of light were initiated by Ciamician at Rome in 1886 by his investigation "On the conversion of quinone into quinol by light" and "On the action of light on nitrobenzene in alcoholic solution." They were resumed actively in 1900 and carried on until 1915 in conjunction with Dr. Paolo Silber, who had collaborated in most of Ciamician's work since 1882. The war interrupted this partnership, which is one of the longest, the most fruitful, and the most disinterested joint efforts in chemical scientific investigation. In the course of this work the following photochemical reactions were discovered: the reciprocal reduction and oxidation of alcohols and carbonylic compounds such as aldehydes and ketones, the reduction of aromatic nitro-derivatives by alcohols and aldehydes, the polymerisation of unsaturated compounds and their isomeric changes—this was extended also to the oximes—the hydrolysis of open- and closed-chain ketones, and also of *cyclo*hexanone and its derivatives, of menthone, of camphor, and of fenchone, the condensation of hydrogen cyanide with ketones and aldehydes, the aldol condensation of alcohols and ketones, and the synthesis and autoxidation of $\gamma$-diketones.

The earlier portions of this series of studies were summarised in a brilliant lecture "On the Chemical Action of Light," delivered before the French Chemical Society in 1908. The later publications on photochemistry treat of the autoxidation of organic acids and of ketones, of bases such as piperidine and nicotine, and of the reduction of copper salts by acetic and benzoic aldehydes. As of especial interest in connexion with autoxidation may be noted that of the *cyclo*hexanones, which yield dicarboxylic acids and the corresponding ketones by opening of the ring, and that of oleic acid, in which the double bond is broken, giving a series of lower fatty acids and providing an explanation of the occurrence of rancidity.

During his researches on light as a chemical agent, Ciamician acquired the conviction that the future of organic chemistry lay in its application to biological chemistry and that the more the chemist makes his methods approximate to those of natural processes the better he will succeed in elucidating the secrets of nature. Ciamician was never interested in making new compounds for their own sake; he held in horror those substances which only figure in Beilstein, and his work followed no fashion, but was always directed towards the solution of fundamental problems. Plotnikov, impressed by the mass of work carried out by Ciamician and Silber since 1900, has stated that this year marks the basic date in the history of photochemistry.

### 5. *Researches on Vegetable Chemistry.*

This group of studies is described in nine notes and twelve memoirs and was initiated by Ciamician in 1908 in collaboration with his assistant, Dr. Ciro Ravenna, now Professor of Agricultural Chemistry at Pisa, and was continued until a few months before his death. The problem involved was that of the origin and the functions of the vegetable glucosides and alkaloids.

These investigations constitute a broad and happy attempt to elucidate the functions and mutual transformations of the substances contained in the living plant; its most valuable result has been the synthesis of glucosides by introducing the aromatic compounds concerned into the plant. Thus, salicin is formed as a result of inoculating growing maize with salicyl alcohol. Further, on introducing nitrogenous substances, and especially amino-acids, into plants which produce alkaloids, the production of the latter is increased: thus, asparagine increases the formation of nicotine in the tobacco plant. In another series of experiments, the influence of certain organic substances on the germination and development of plants was studied with a view to ascertaining the function of the alkaloids. From all this work it appears to be indicated that such accessory products as alkaloids, produced in the living plant, are not excretionary products, but exercise a function which may be similar to that of the hormones in animals.

Ciamician summarised his work and its conclusions in an elegant and lucid address "On the Biological Significance of Alkaloids in Plants," delivered in October, 1921, at the meeting in Trieste of the Italian Association for the Advancement of Science. This was the last occasion on which he spoke in public, and he concluded the account of this very beautiful piece of synthetic work by stating—"The conclusion deduced from what we know at present, is that the plant practises a chemistry corresponding to that practised in the laboratory, but does so by means infinitely more simple than ours, although with objects similar to ours. The plant organisation is less differentiated than that of animals, and volitionary manifestation is less developed, but amends are made by the exercise of a highly perfected chemical technique; the plant consciousness is a chemical consciousness."

6. *Memoirs and Notes on Physical Chemistry.—Addresses and General Discourses.*

The first work of Giacomo Ciamician was on physical chemistry, and he continually followed the development of this science; indeed, he made notable contributions to it by a few but fundamental papers. The note "On a Lecture Experiment for Demonstrating Raoult's Law," and that "On the Theory of Electrolytic Dissociation," in which he was perhaps the first to advance the idea of complexes formed between the ions and the molecules of the solvent (*i.e.*, solvates of the ions), are worthy of remark. Again, the paper "On the Relations between the Chemical Constitution and the Property of forming Solid Solutions of Organic Compounds" was the starting point of fruitful investigations in his own laboratory and culminated in the classical work of Bruni on solid solutions. The note on "Considerations on the Nature of Chemical Affinity and of the Valency of the Atoms," published with Padoa in 1918, came early in the introduction into our science of the electronic constitution of the atom, and some of the views put forward are really profound and merit further development now that the secrets of atomic constitution seem in the main unveiled. Ciamician's point of view in the treatment of questions of general interest was a very admirable one. In his inaugural address on "Chemical Problems of the New Century" in 1903 he showed a real gift for the dignified but at the same time efficient popularisation of science; this power was still further developed in a lecture on "Problems and Objects of Modern Organic Chemistry," given at Vienna in 1907, in those on "Organic Chemistry in Organisms" at Parma in 1908, and on "The Co-operation of the Sciences" at Naples in 1910, and, lastly, in his magnificent discourse on "The Photochemistry of the Future," read at New York in 1912 before the 8th International Congress of Applied Chemistry. In this sparkling address he developed many fundamental conceptions which have been taken up in numerous later well-known utterances by others; he insisted on the need for setting plants to work, so that we may conserve, so far as may be possible, our natural wealth of fossil fuels, which is really small, and of applying photochemistry in desert regions to the utilisation of the solar radiation.

"On the arid earth," he says, "will spring up industrial colonies without soot and without chimneys: forests of glass tubes and greenhouses of all sizes will rear themselves before the sun, and in this transparent apparatus will proceed those photochemical processes of which the secret and the monopoly are at present held alone by the plant, but which human industry will learn how to wrest from it. That knowledge will be usefully applied in quite new ways, because whilst nature is incapable of haste, humanity can act more speedily; if, in some distant future, the moment arrives when fossil carbon becomes exhausted, it will not entail the death of civilisation, for life and its amenities will endure so long as the sun shines." He took up this argument again, and in a form which appealed to a larger public, in his article on "Chemical Industry without Carbon," published in the "Nuova Antologia" in 1917.

Amongst other writings of Ciamician which call for special mention are those devoted to the memory of Stanislao Cannizzaro and of his intimate friend Augusto Piccini, and the discourse, pregnant with thought, delivered at the celebration of the 70th birthday of Guglielmo Koerner.

The vast output of scientific work of outstanding merit produced by Giacomo Ciamician has been very briefly summarised in the above pages; it appears the more remarkable by contrast with the penury of his laboratory, which made his work a real struggle. He was an incomparable master in the laboratory and the lecture theatre and a great stimulus to energetic work. His numerous pupils now fill the most important chairs of chemistry in Italy and hold high the renown of Italian chemistry; amongst them may be mentioned Angeli, Magnanini, Plancher, Garelli, Bruni, Mascarelli, Ravenna, Boeris, Cambi, Barbieri, Padoa, and Ciusa, together with Zanetti and Rimini, who have passed away. He initiated and vigorously inspired much original work which did not come strictly within his own field; thus arose the investigations of Bruni, Garelli, and Padoa. Himself indefatigable, he inspired in all a noble enthusiasm for assiduous work. His lectures, to which he devoted himself like an apostle, were models of elegance, of precision, and of vivacity, as well as in the choice of experiments; they were one of his great passions, and it was always for him a sad day when he could not appear before his class, which welcomed him with growing applause, repeated at the close of the lecture. Against the advice of his friends and students, and when already attacked by fever in November 1921, he wished to commence his courses in general and in organic chemistry; immediately afterwards he was laid aside by the insidious malady which took him from us.

Giacomo Ciamician was a member of practically all the Italian Academies and scientific bodies, as well as of a large number of foreign societies. He had been President of the Italian Society for the Advancement of Science and of the Italian Association for Pure and Applied Chemistry; he was an honorary member of the

English, French, German, and American Chemical Societies, and a foreign member of the French Academy of Sciences. He was an honorary LL.D. of the University of Glasgow and an honorary member of the Royal Institution of Great Britain. He did not seek dignities, but he was a Cavaliere dell' Ordine del Merito civile di Savoia and a Chevalier of the Legion of Honour. After 1910, he worked actively as a member of the Italian Senate. He had a distaste for militant politics, but nevertheless his voice did not fail the Senate when questions arose which concerned education or the chemical industries; his principles were broadly liberal and he was greatly attached to his native Trieste. Immediately after his graduation he left Vienna, although he could have found there an ample career and ample means for carrying out his work, and came to Italy. At the death of Professor Weidel, an occasion offered for his election as Professor in Vienna with honours, means of work, and emoluments far greater than those he enjoyed in Italy; notwithstanding his gratitude to his former teacher, Professor Lieben, he never thought for a moment of abandoning Italy.

During the war he devoted his great abilities with much self-sacrifice but with juvenile enthusiasm to the work allotted to him; this work was arduous and intense and, whilst without doubt valuable to our country, undermined his already shaken constitution. Towards the end of the war he was smitten by two great sorrows, first, the death of his mother and later that of his dearly-loved sister, Carolina, the wife of Professor R. Nasini. The last great pleasure of his life was to witness the liberation of his native Trieste. Trieste had always held him in affection and esteem as one of the elect of her sons, and decided on his death that the Via degli Armeni, in which is the house of his aunts on the mother's side where he passed his youth and which he made his home when in Trieste, should be renamed the "Via Giacomo Ciamician." On the house in which he was born, 21 Via S. Martiri, the Municipality has placed a bronze medallion with his portrait and an inscription by the well-known patriot and scholar, Senator Attilio Hortis.

Ciamician was of a benign and fine presence; his blue eyes expressed his great kindliness and revealed the simplicity of his nature; he was easily moved to anger, but incapable of harbouring offence. He had a genius for friendship and lavished a noble affection upon his intimate associates; he was simple and upright in private life and a model of the civic virtues. His mind was open to all the great modes of intellectual expression; amongst the arts he loved above all that of music, and in this, even in musical Bologna, he was considered as one of the highest authorities. The Queen Margherita held him in affection and enjoyed his thoughtful and animated conversation; he had friendships amongst all the chief chemists of his day, more particularly with Emil Fischer, who several times proposed him for the Nobel prize, with Albin Haller in France, and with Henry E. Armstrong.

Bologna was proud to look upon him as one of her citizens and followed anxiously the vicissitudes of his last illness, an insidious malady from which so rapid an end was not to be foreseen. He passed away quietly in the arms of his brother-in-law, Professor R. Nasini, and of his nephew, Dr. A. G. Nasini, and surrounded by his relatives from Trieste; most of his former students had collected in Bologna to be present at the end. They took part in the last solemnities when he was laid to rest on a cold and bright January day; to the accompaniment of Beethoven's funeral march, as Ciamician had wished, the great procession passed among the mourning populace through the streets of the old turreted city he had loved so well.

A memorial stone has been placed by his students on the house which he had always occupied, No. 3 Via Guido Reni. In a short time the new Chemical Institute will be inaugurated: Ciamician had devoted much of his activities to this project and its execution and hoped much from its future. It will carry on its façade the inscription "Istituto Chimico Giacomo Ciamician." An honour worthy of the great man of science.

RAFFAELLO NASINI.

---

## SAMUEL HENRY DAVIES.

BORN SEPTEMBER 19TH, 1870; DIED MAY 9TH, 1925.

SAMUEL HENRY DAVIES was born at Liverpool on September 19th, 1870, the son of Richard Davies, pharmacist. He received his early schooling in Liverpool, and was then for four years at the Friends' School at Sidcot in Somerset, where he already showed a keen interest in chemistry. He studied successively at University College, Liverpool, and Owens College, Manchester, and graduated B.Sc. at Manchester in 1890 (M.Sc. in 1893), winning a scholarship which took him to Heidelberg. Here, under the direction of Victor Meyer, he carried out a research on "Alkyl and Acetyl Sulphides," which was published in the *Berichte* in 1892, and a minor research with Emil Feith on the "Action of Hydroxylamine Hydrochloride on Acetomesitylene."

After returning to England Davies held university posts as demonstrator first at Manchester and later at Leeds, and won the esteem of professors and students. His professor at Leeds says: "I never parted with a demonstrator more reluctantly, for he was an excellent teacher full of life and go, ready to take up and carry out any promising new plans of instruction."

In 1893 Davies was appointed the first head of the chemical department at the new Battersea Polytechnic; into the organisation of this department he threw himself with whole-hearted and characteristic energy. Here he remained until in 1896 he was appointed chemist to Rowntree and Co. at the Cocoa Works, York. This post he held for more than twenty-five years, during which the original small laboratory with one assistant grew under his direction to a finely-equipped department with a staff of fifty.

Davies was a man of the widest human sympathies and his work at York did not end with his duties as chemist but covered a varied field; he lived a very full life both in the works and in the city. He took the keenest possible interest in the welfare of the workers and in their various clubs and social activities, devoting much time in the earlier days to the swimming, rowing, and football clubs.

In 1907 Davies married Miss Edith M. Oliver and about this time was elected a member of the York City Council, on which he represented Castlegate ward for nine years. He was a strenuous advocate of the feeding of necessitous school children and of a clean milk supply and was the author of pamphlets published by the York Health and Housing Reform Association.

Much of Davies's work for the firm could not be made the subject of publications, but in 1904 he published (with McClellan) a paper on the amount of fat contained in cocoa beans of different origin and in 1912 (with J. S. Bainbridge) a valuable paper on "The Essential Oil of Cocoa." He directed much attention to the general problems of factory working, and papers published in 1903—1904 on the "Relative Efficiency of Insulating Media" embody the results of detailed research on the comparative value of materials used for covering steam-pipes. He also wrote on factory ventilation and lighting and devised a simple and rapid method for the estimation of carbon dioxide in the atmosphere.

On behalf of Rowntree and Co. Davies made journeys in many countries, notably in South America and the West Indies; he returned to the West Indies several times in connection with the development of Rowntrees' estates. He always maintained his interest in these islands and was a prime mover in establishing the Technical College in Trinidad, of which he was appointed a governor.

Davies was a member of the Fell and Rock Climbing Club and, an enthusiastic lover of mountains, spent many summer holidays in the Tyrolese Alps.

From 1919 Davies suffered from ill-health and after a breakdown in 1922 relinquished his full time duties at the cocoa works, but was still retained by the firm as consultant. He built himself a new home and a laboratory at Jordans in Buckinghamshire, where he intended to continue research work, but his health broke down completely and he passed away on May 9th, 1925.

Davies possessed an unusual charm of manner and disposition and was beloved by a wide circle of friends; excellent chemist as he was, chemistry was to him but one means of approach to his fellow men. A writer in the *York Gazette* says of him: " When S. H. Davies saw something to be achieved which could bring gladness and essential prosperity into the lives of his neighbours, he sought for this with his whole soul and strength, however strong and influential the forces against him," and one who worked with him in his later years rightly described him as " gentle and charitable, indulgent to others, severe to himself and unwearying in service to friends." His was a noble nature and we who knew him are sorrowful that he has left us so soon.

REGINALD BROWN.

---

## WILLIAM HENRY DEERING.

BORN DECEMBER 19TH, 1848: DIED SEPTEMBER 5TH, 1925.

WILLIAM HENRY DEERING was the youngest son of W. Deering of Gravesend. He received his early education at the City of London School and in 1864 entered the College of Chemistry as a student under Hoffman. After short periods as assistant to Sir Benjamin Brodie at St. Bartholomew's Hospital and with William Odling at Oxford, in 1867 he joined the staff of Sir Frederick Abel, Chemist to the War Department, at the Royal Arsenal, Woolwich. He spent the rest of his life, until his retirement in 1909, in the Government service, becoming himself Chemist to the War Department in 1905.

Like that of many other civil servants, Deering's work was unknown to the general public, but he played no small part in the application of chemical science to military materials which showed so remarkable a development towards the end of last century. Although the introduction of cordite is associated with the name of Sir Frederick Abel, the fundamental researches which led to its adoption in the British Service necessarily depended on his assistants, and of these Deering and his colleague, the late William Kellner, were mainly responsible for the work. It is sufficient testimony to the thoroughness and completeness of their labours that, in spite of continuous efforts to improve upon it, the cordite of to-day is substantially the same as that introduced into the Service in 1889.

In addition to his work on cordite, Deering was called upon, in the course of his long service, to deal with a large variety of chemical and physical problems in connexion with explosives and other military stores. He carried out much important investigation in perfecting electrically-fired detonators for use in the field.

As regards contributions to the literature of their profession, scientific officers of the public service suffer from certain disabilities. It frequently happens that their more important work is of a confidential nature, or, if not, that it is published in the form of a report by the Head of the Department, in which the part played by individuals is not shown. To these facts, coupled with Deering's marked distaste for publicity, is due the relatively small number of papers under his name. Perhaps the most important are those (with Abel) on the conditions in which carbon exists in steel (J., 1883, **43**, 303) and (with Kellner) on the measurement of pressure by the crusher gauge (*Proc. Roy. Soc.*, 1895, **57**, 404). But he also contributed papers to the Society's *Journal* on water analysis and on lead salts, and to other journals on mineral oil and certain fatty oils. He was responsible for the article on "Explosives" in the first edition of Thorpe's "Dictionary of Applied Chemistry" and received a medal for a lecture on the same subject before the Royal Society of Arts.

Deering's knowledge of chemical literature was encyclopædic. He remained a student throughout his career and had an exceptionally retentive memory. There were few subjects upon which he could not, without hesitation, refer an inquirer to the more important papers dealing with them. In the laboratory, his work was characterised by meticulous care. He took nothing for granted, satisfied himself at every stage of the accuracy of his work, and eliminated or evaluated every possible source of error. He was a good linguist, speaking French and German fluently. He had also a working knowledge of Italian and the Scandinavian languages.

Inclined to be somewhat impulsive and outspoken, and intensely disliking insincerity of any kind, it was only those who knew Deering well who could realise his kindness of heart. He was incapable of an ungenerous act, and appreciated the work of his humblest assistant.

Deering lived for his work, and the Companionship of the Imperial Service Order, conferred upon him in 1906, was an inadequate recognition of a life of really devoted service to his country.

Deering married, in 1905, Isabel, daughter of Thomas Cowie of Blackheath. Upon his retirement, he moved to Devonshire and, after some years of failing health, died at Torquay on September 5th, 1925.

A. V. E.

## FRANCIS ROBERT JAPP.

BORN FEBRUARY 8TH, 1848: DIED AUGUST 1ST, 1925.

FRANCIS ROBERT JAPP, a member of a family of Dutch origin, whose name was well-known half a century ago in the eastern districts of Forfarshire, was born in Dundee on 8th February, 1848, the youngest son of James Japp, minister of the Catholic Apostolic Church in that city. His earliest education was obtained in the town of his birth, in part at the High School there; but in 1861, at the age of thirteen, he was sent to St. Andrews, the reputation of which as an educational centre stood then, as now, very high. After three years spent at the Madras College, he entered the University as a student in the Faculty of Arts.

The course of study for the Arts degree extended, at that time, over four winter sessions of five to six months each (there were no summer sessions), and the subjects studied were Latin, Greek, Mathematics, English, Logic and Metaphysics, Moral Philosophy, and Natural Philosophy. While at St. Andrews, Japp contracted a lifelong friendship with John Masson, essayist and author of "Lucretius, Epicurean and Poet."

After graduating M.A. at St. Andrews, Japp entered the University of Edinburgh in 1868 as a student of law; but his period of study at Edinburgh proved to be a short one. In the summer of 1869 his health broke down and he was compelled to relinquish his legal studies and to reside abroad, at Pau and at other health resorts. For two years, from the spring of 1871 to the spring of 1873, Japp resided in Germany, at Göttingen, Berlin, and Heidelberg; and although, during a portion of that time, he attended lectures on International Law and on German Literature, he had, even then, abandoned his intention of prosecuting the study of law. The record of the following two years will be more interesting if told in Japp's own words, communicated to the writer in a letter some years ago: "In the spring of 1873, I returned to England and spent the time partly in London, partly in Scotland. I had by this time taken up the subject of chemistry, in which I had always been interested. In the autumn of 1873 I returned to Heidelberg and began the study of that subject under Bunsen. I was then twenty-five years of age, and my friends, who had long despaired of my ever taking up anything seriously, regarded this last step as the crowning folly of a hopeless career. In 1875 I graduated Ph.D. at Heidelberg (only *insigni cum laude*). I was anxious to get all examinations behind me as soon as possible and, I fear, rather hurried matters. The Heidelberg Ph.D. at that time required no 'dissertation' and was rather a worthless degree;

Yours sincerely,
F. R. Japp.

[*To face p.* 1008.]

there was no practical examination—merely an 'oral' of two hours. I stayed with Bunsen until the end of the summer semester, 1876, devoting the winter semester to the separation and preparation of various rare elements and the summer to a rather impossible piece of research which Bunsen had suggested and which led to no result. I also heard lectures by Hermann Kopp, on the History of Chemistry; by Hermann Quincke, on Physics; and by Blum, on Mineralogy. Contemporaries of mine in Bunsen's laboratory were John Gibson, J. E. L. Shadwell, C. Loring Jackson, W. F. Hillebrand, T. H. Norton, F. P. Treadwell, Charles Otto Trechmann, Hans Jahn, and Siegmund Gabriel."

From Heidelberg Japp proceeded to Bonn to work in the laboratory of August Kekulé, who had, some years previously, been appointed to the Chair of Chemistry in the University and had attracted to his Institute large numbers of young chemists of different nationalities. Whether the young Scottish chemist felt, as did van 't Hoff, that the laboratory of Kekulé was a sacred temple to be entered only with feelings of reverence and of awe, we cannot say; but the Memorial Lecture on Kekulé, delivered by Japp in 1897, bears, in its every line, clear and eloquent testimony of the esteem and admiration which he felt for his new teacher, who, although no longer at the height of his physical power, preserved his mental faculties unimpaired and could still inspire work of unsurpassed excellence. It was in the palatial laboratory at Bonn that Japp, under the more immediate guidance of G. Schultz and of Anschütz, first entered on that course of chemical investigation which he pursued with such wholehearted devotion and success for over thirty years. Among Japp's contemporaries at Bonn were P. Phillips Bedson, Henry Forster Morley, Richard Taylor Plimpton, and Shadwell.*

* The writer is indebted to Geheimrat Professor R. Anschütz for the following reminiscences of Japp's period of study in Bonn:

"Japp wohnte in Bonn mit seiner Mutter in einem Haus in der Kölnstrasse im Nordosten Bonns weit weg von dem in Poppelsdorf gelegenen chemischen Institut. Das beschränkte stark seinen Verkehr mit seinen Studiengenossen, die er nur im Laboratorium sprach; von studentischen Kneipereien hielt er sich fern. . . .

"Damals war Gustav Schultz Kekulé's Privatassistent und ich Vorlesungsassistent. . . . Soweit es meine Arbeiten für Kekulé gestatteten, arbeitete ich mit Schultz über das Phenanthren. Japp schloss sich an uns an und wir lernten im persönlichen Umgang die liebenswürdigen Eigenschaften des um einige Jahre älteren Fachgenossen schätzen, der nicht nur die deutsche Sprache völlig beherrschte, sondern sogar einen ausgesprochenen Sinn für den deutschen Volkshumor an den Tag legte. . . .

"Da Gustav Schultz und ich unsere Arbeitsplätze neben Kekulé im Privatlaboratorium hatten, so brachte es Japp's Entschluss mit uns zu

In 1878, Japp returned to Scotland and continued his research work in the laboratory of Professor Crum Brown, Edinburgh. Later in the same year he was chosen by Professor (later Sir) Edward Frankland, out of a large number of candidates, to take charge of the Research Laboratory which was then being established at the Normal School of Science, South Kensington, and to devote his whole time to the supervision of the research students. In 1881, when the Science Schools were reorganised by the Science and Art Department, Japp was promoted to the rank of Assistant-Professor in what was then called the Royal School of Mines and Normal School of Science, and which, at a later date, became the Royal College of Science. Here, under E. Frankland and later under T. E. Thorpe, who succeeded to the Chair of Chemistry in 1885, Japp continued to direct the work of research in, as well as to lecture on, organic chemistry. Although recognised as a brilliant research chemist, Japp felt that he was adversely affected in his candidatures for a Chair by his lack of experience in the conduct of a general laboratory, and in 1889, on the departure of P. F. Frankland to occupy the Chair of Chemistry at Dundee, Japp requested and was given a share in the teaching work of the large laboratories. Unsuccessful in his candidature for the Chairs at Leeds in 1885 and at Dundee in 1889, Japp was appointed to the Chair at Aberdeen in 1890, in succession to Thomas Carnelley.

The twelve years spent in London constituted, perhaps, the " Golden Age " of Japp's scientific life. Filled with an enthusiasm for research, Japp not only found his work at the Normal School (and Royal College) of Science for the most part congenial and satisfying, but he also greatly enjoyed participating in the active scientific life which found its focus in the Chemical Society, at the meetings of which he was often a conspicuous figure. In the discussions which there took place, as the writer is informed, " opportunity arose for his revealing, not only his dry humour, but also his profound knowledge of chemical literature and a width of classical and philosophical reading altogether beyond the range of the attainments of the great majority of his contemporary

arbeiten mit sich, dass er mit Kekulé genauer bekannt wurde, als es sonst geschehen wäre. Kekulé fand bald Gefallen an Japp's immer bedächtiger aber stets klarer Art sich in der Unterhaltung über wissenschaftliche Fragen auszusprechen.

" Als im Jahre 1878 die Stelle eines Demonstrator der organischen Chemie am Royal College in London bei Frankland zu besetzen war, bewarb sich Japp darum, unterstützt durch ein ausgezeichnetes Zeugnis von Kekulé, und Frankland gab ihm vor anderen Mitbewerbern den Vorzug. Wie mir Japp später mitteilte, habe Frankland besonders unsere Beweisführung der Konstitution des Phenanthrens gefallen."

chemical colleagues." Japp valued also the personal contacts with the leaders and fellow-workers in chemical science which residence in London made possible. On the other hand, Japp's scientific accomplishments, his well-stored and cultured mind, and his remarkable personality won the admiration, regard, and esteem of his fellow-chemists, and he was early called to serve on the Council and the Publication Committee of the Chemical Society. Although, to the great regret of his many scientific friends, Japp seldom, after his departure in 1890, re-visited London or took part in the gatherings of chemists elsewhere, one could not fail to note how, in later years when settled at the northern University, he sometimes looked back with something of wistful yearning to the inspiration and stimulating fulness of life which the Metropolis offered to the scientific worker.

While at the Royal College of Science, Japp gathered round him a large number of able and enthusiastic students, and research was prosecuted with great activity. About half the total number of scientific papers which Japp published, either independently or in collaboration, appeared during his London period.

During this period, also, Japp contributed to the advancement of chemistry by the publication, in collaboration with E. Frankland, of a text-book of Inorganic Chemistry which was "constructed on those principles of Classification, Nomenclature, and Notation which, after an experience of nearly twenty years, have been found to lead most readily to the acquisition of a sound and accurate knowledge of elementary chemistry." The composition of the book was mainly the work of Japp, and the more theoretical sections, such as the chapter on the Atomic Theory, are excellent examples of clear and well-reasoned exposition. Owing, doubtless, to the adoption of Frankland's constitutional formulæ and nomenclature, which did not find favour with contemporary chemists, this work did not have the circulation which it deserved.

Japp also collaborated with Frankland in the preparation of a new edition of the latter's "Lecture Notes on Organic Chemistry."

From the Royal College of Science Japp proceeded, as has been noted, to the University of Aberdeen. He was, perhaps, fortunate in the date of his appointment, for it fell on the eve of a very great and rapid development of the University, marked, not only by the erection of imposing buildings and an increase in the number of its teachers, but also by a renewed activity in literary and scientific investigation. In all this progressive movement the Chemistry Department, under Japp's guidance and enthusiasm, played a notable part.

Until 1896, the Chemistry Department of the University of

Aberdeen was housed in a series of four or five small rooms, badly lit and badly ventilated, which afforded accommodation of a very inadequate character for only two or three advanced students working at one time. Two of the rooms, in which the classes in practical chemistry for medical students were held, were fitted with a circular table without sink and without water-supply other than that contained in a jug placed on the narrow working bench. In these rooms even the most primitive arrangements for the extraction of fumes were wanting, so that when fifteen or twenty students were vigorously boiling off excess of aqua regia, the figure of Japp, seated on a stool in the centre of the space enclosed by the circular work-bench, could be only faintly discerned through a mist of acid vapours.

With such accommodation at his disposal, it was clear that it would be impossible to build up a school of chemistry of any importance, and Japp therefore set about the task of arousing public opinion and of stimulating the University authorities to a recognition of the claims of chemistry to more adequate accommodation. His reward came at last, and in 1896, with the carrying out of a scheme of University extension, Japp found himself installed in laboratories which, at that time, could be regarded as palatial, but which, in the space of thirty years, have become inadequate for the requirements of the present day.

Development, however, took place in directions other and more important than towards new buildings. Previously, the work of the Chemistry Department had consisted, almost entirely, in the teaching of elementary chemistry to medical students, but soon after Japp's installation as Professor at Aberdeen, a Faculty of Science was instituted, courses of instruction leading to the degree of B.Sc. were introduced, and a school of advanced chemical study rapidly grew up. It must, indeed, be regarded as not the least important and valuable of Japp's contributions to the advancement of chemical science that, in an area where there had previously existed no school of advanced chemical training or tradition of chemical study, he created a vigorous school of chemical instruction and research from which there has issued a succession of chemists, many of whom occupy important academical and industrial posts in various parts of the world.

While at Aberdeen, Japp delivered, each year, two courses of lectures, one on elementary inorganic chemistry and one on organic chemistry; and it must be confessed that as a lecturer to young Scottish students, perhaps the most testing audience for any lecturer to address, Japp fell somewhat short of achieving complete success. It may be that he did not sufficiently bear in mind that the great majority of the students attending his elementary class came to him entirely ignorant of chemistry or were hearing his lectures, not from choice, but under the compulsion of regulations; and it may also be that he was, temperamentally, somewhat out of touch with the mind of the average young student. As a consequence, the generous appreciation of which the Scottish student is capable sometimes degenerated, unfortunately, into an irritating disturbance or even a boorish noisiness. This behaviour on the part of his students was a constant source of annoyance and worry to Japp, and even told adversely on his health. On one occasion, when the disturbance was more than usually bad, Japp was roused to protest. Halting in the course of his lecture, he gazed on his students for a few moments and said: "Gentlemen, I have been a member of four Universities—London, Edinburgh, St. Andrews, and Aberdeen—and I find that the higher the latitude the lower the breeding."

For his comparative lack of success with his elementary class, his success as a lecturer on organic chemistry to advanced students in science must have been some compensation. In this case, the lecturer was dealing with a branch of chemistry to which he had devoted his life and he was in the presence of a serious body of students to whom he gave of his best. Drawing on his wonderful knowledge of the subject and brightening, here and there, the intricacies of a problem in constitution with a touch of personal reminiscence, Japp revealed to his students the main features and course of development of organic chemistry in a manner which, to the student, was most impressive and showed Japp's mastery of detail, clearness of thought, and accuracy of language.

In all his teaching, whether in the lecture room or in the laboratory, Japp was intolerant of haziness of thought and slovenliness of manipulation; and the high standard of clear thinking, accurate expression, and neatness of experimental work which he set for himself and demanded of his students did not fail to make an ineffaceable impression on his pupils.

It was, however, in the research laboratory that Japp was most at home and at his best. With the help of a research assistant, maintained by means of a grant from the Royal Society, and in later years with the assistance of his own graduate pupils, Japp was enabled to maintain, although in somewhat diminished volume, his output of research work. During his tenure of the Chair at Aberdeen, upwards of forty papers were published by Japp in collaboration with his private assistants or research students. Although the last paper to bear his name appeared in 1905, Japp continued to inspire and direct the research work of members of his staff; and, with a modesty approaching almost to self-depreciation, he frequently effaced himself in order that his reputation and seniority might not deprive his younger colleagues of any credit to which they might be entitled. This self-effacement was exhibited, not only in connexion with the publication of research, but also in connexion with the organisation and development of the teaching work of his Department.

Although always jealous of the interests of his Department and active in its development, Japp took no prominent part in University politics or in the general work of administration. Nor did he take much part in the life of the various University Societies. "Whenever they" (the officials of the societies) "came to me for an address, I used to give them a sovereign, which I have no doubt was infinitely more acceptable." This, of course, was not the case, and one cannot but regret, from the point of view of the students, that Japp refrained from making use of the opportunities which offered of impressing on a larger body of the students something of his own remarkable personality, of imparting to them something from his great store of scientific and literary lore, and of encouraging in them the cultivation of the wide and philosophic outlook which he himself possessed. Japp, however, had little of the missionary spirit and no great love for the platform or the market place; and he preferred to share the treasures of his mind chiefly with those who were associated with him in research or had the good fortune to enjoy his friendship.

Commencing, as Japp did, his career as a chemical investigator in the laboratory of Kekulé, who, to quote from the Memorial Lecture, "brought an intellect of incomparable power and subtlety to bear on problems so abstruse, so remote from the everyday thoughts and interests of mankind, that the vast majority even of educated persons have never heard either of the problems or of the man who did so much to solve them," it is, perhaps, not surprising that Japp's research work was by no means "popular." It concerned itself at no point with problems of everyday experience or of immediate industrial importance, but dealt with many difficult problems of chemical constitution which required for their solution greater chemical acumen and a more profound knowledge than is the case with many investigations which make a more direct appeal to the lay mind. Endowed with a very retentive memory, Japp took to heart, and passed on to his pupils, the counsel which Liebig gave to Kekulé: "If you want to be a chemist, you will have to ruin your health; no one who does not ruin his health with study will ever do anything in chemistry nowadays." The *Journal of the Chemical Society*, the *Berichte*, and the *Annalen* were Japp's constant companions, and the *Jahresbericht* formed his holiday reading. As a result he acquired an incomparable knowledge of organic chemistry which, together with a great capacity for accurate and laborious experimental work, the power of clear thinking and reasoning, and a highly developed "chemical instinct," enabled him to solve successfully many obscure problems of chemical constitution. Japp, moreover, was imbued with the spirit of the true scientific investigator intent only on eliciting the truth, without thought of personal ambition or material gain.

The raw materials of almost all of Japp's research work were phenanthraquinone, benzil, and benzoin; and from a paper (J., 1897, **71**, 123) which may almost be regarded as the *apologia* of his scientific life one learns that the main objects of the systematic study of the condensations of the ketones and keto-alcohol mentioned were the synthesis of cycloids and the comparison of the properties of ortho-diketones of the aromatic series with those of the α-diketones or keto-alcohols of the aliphatic series. As he pointed out: "At that time, Ladenburg's 'prism' formula could still be seriously put forward as a satisfactory expression of the reactions of benzene; and in this formula the ortho-carbon atoms are not directly united. Every condensation, therefore, which bore out the foregoing analogy" (between aromatic and aliphatic α-diketones) "was a fresh argument against the 'prism' formula. Indeed, it is cumulative evidence of this character, rather than any definite disproof, that has caused the 'prism' formula to be withdrawn from discussion."

It may be remarked that some of Japp's earlier investigations (*e.g.*, J., 1880, **37**, 410; 1882, **41**, 146), which were undertaken partly with the object of throwing light on the constitution of phenanthraquinone itself, supported Graebe's peroxide formula; later work, however (*e.g.*, J., 1883, **43**, 27), furnished a very strong argument in favour of Fittig's formula, which was subsequently always employed.

The success with which the main object of Japp's research work, the synthesis of cycloids, was realised, is well seen from the following list of the various classes of compounds formed in different condensation processes:

*Oxazoles*.—1. By the interaction of α-diketones with aldehydes and ammonia (J., 1880, **37**, 669; 1881, **39**, 225). 2. From benzoin and nitriles (*ibid.*, 1893, **63**, 469).

*Iminazoles*.—1. *Ordinary* (*secondary*) *Iminazoles*.—From α-diketones, aldehydes, and ammonia (*ibid.*, 1882, **41**, 146, 157, 323; 1886, **49**, 464; 1887, **51**, 552, 557). 2. *Tertiary Iminazoles and*

*Quaternary Ammonium Compounds.* From α-diketones and primary amines of the formula $R\cdot CH_2\cdot NH_2$ (*ibid.*, 1895, **67**, 32).

*Furfurans.*—By the action of hydriodic acid on the condensation products of α-diketones with ketones (*ibid.*, 1890, **57**, 662).

*Indoles.*—By the condensation of benzoin with primary benzenoid amines (*ibid.*, 1894, **65**, 889).

*Azines.*—By the action of ammonia (1) on benzoin and (2) on α-diketones (*ibid.*, 1886, **49**, 828; 1887, **51**, 98).

To the above series of compounds one may also add *lactones*, *pyrrolones*, and *pyrroles*.

In addition to the foregoing classes of compounds, all of which are heterocyclic, a number of pentacarbon ring compounds were also synthesised. Chief among these are *anhydracetonebenzil*, obtained by the condensation of benzil with acetone (J., 1885, **47**, 21); *anhydracetonebenzilcarboxylic acid*, by the condensation of benzil with acetonedicarboxylic acid (J., 1897, **71**, 139); and two isomeric *anhydrobenzil-lævulic acids*, by the condensation of benzil with lævulic acid (J., 1897, **71**, 144).

For the most part, the superstructure of Japp's synthetic work was founded on a new reaction which he discovered, the condensation of ketones with aldehydes in presence of ammonia, and on his use of caustic potash as a condensing agent. The careful investigation of a large number of such condensation reactions and the elucidation of the constitution of the compounds produced in these reactions or prepared as derivatives therefrom, not only formed a very important and valuable contribution to synthetic organic chemistry, but also enabled Japp to elucidate the constitution of important compounds prepared by other investigators. Thus, by condensing benzil with benzaldehyde in presence of ammonia, lophine was obtained, and the constitution of this compound, first prepared by Laurent and by Fownes, was thus shown to be $\begin{matrix} C_6H_5\cdot C\cdot NH \\ \| \\ C_6H_5\cdot C - N \end{matrix} \!\!\geqslant C\cdot C_6H_5$. By the reduction of lophine, amarine, $\begin{matrix} C_6H_5\cdot C\cdot NH \\ \| \\ C_6H_5\cdot C\cdot NH \end{matrix} \!\!> CH\cdot C_6H_5$, is formed (J., 1882, **41**, 323; 1900, **77**, 608). Further, condensation of benzoin with benzonitrile under the influence of concentrated sulphuric acid showed that Laurent's benzilam (Zinin's azobenzil) is triphenyloxazole; and the oxidation of anhydracetonebenzil to desyleneacetic acid and the reduction of this acid to βγ-diphenylbutyric acid, which was found to be identical with Zinin's pyroamaric acid, established the constitution of the latter. By other condensations, also, important light was thrown on the constitution of glyoxaline, $\begin{matrix} CH\cdot NH \\ \| \\ CH - N \end{matrix} \!\!\geqslant CH$, glycosine, $\begin{matrix}CH\cdot NH \\ \| \\ CH-N\end{matrix}\!\!>\!C\cdot C\!<\!\!\begin{matrix}NH\cdot CH \\ \| \\ N-CH\end{matrix}$, and lepiden (tetraphenylfurfuran).

Whilst the scientific investigations to which reference has just been made established Japp's reputation as a chemist of the first rank, the address which he delivered as President of the Chemistry Section of the British Association in 1898 made a wider appeal, and showed that he was not a mere specialist with his interests confined within the bounds of his own narrow branch of work, but that he interested himself also in the more fundamental problems of science and of life.

In that address, Japp emphasised the importance of the discoveries in stereochemistry because they furnish a reply "to the most fundamental question that physiology can propose to itself—namely, whether the phenomena of life are wholly explicable in terms of chemistry and physics; . . . or whether, on the contrary, there are certain residual phenomena, inexplicable by such means, pointing to the existence of a directive force which enters upon the scene with life itself, and which, whilst in no way violating the laws of the kinetics of atoms, determines the course of their operation within the living organism." His whole address was an argument, based on the results of stereochemical investigation, in favour of the doctrine of vitalism as revived by the younger physiologists; and in it his purpose was to show that "living matter is constantly performing a certain geometrical feat which dead matter, unless, indeed, it happens to belong to a particular class of products of the living organism and to be thus ultimately referable to living matter, is incapable—not even conceivably capable—of performing."

The argument may be briefly summarised. Although in nature most asymmetric compounds occur in one of the optically active forms only, it is found that when it is attempted to synthesise such a compound from symmetric substances the product of the synthesis is always inactive. As Pasteur said: "Artificial products have no molecular asymmetry; and I could not point out the existence of any more profound distinction between the products formed under the influence of life and all others." The inactive forms, however, obtained by chemical synthesis can be resolved into the two oppositely active isomerides by means of enzymes, moulds, etc., and even, in some cases, by crystallisation. Since the racemic sodium ammonium tartrate could be resolved into the active forms by the symmetrically acting process of crystallisation, and these active forms could be separated by hand, it was thought that "the barrier which M. Pasteur had placed between natural and artificial products" was thereby broken down; and this was undoubtedly the view held by the majority of chemists.

But had it? Japp intimated in his address that he had for some time held a contrary opinion, and he again asked the question which had also previously been posed by Crum Brown: "Is not the observation and deliberate choice by which a human being picks out the two kinds of crystals and places each in a vessel by itself the specific act of a living organism of a kind not altogether dissimilar to the selection made by *Penicillium glaucum?*" This question Japp discussed and answered in the affirmative. The artificial, racemic compound, certainly, had been resolved into the active forms by the symmetrical process of crystallisation, but these two forms had not thereby been *separated* from each other; both active forms were present side by side. Their separation "requires the living operator, whose intellect embraces the conception of opposite forms of symmetry, to separate them." . . . "Conscious selection here produces the same result as the unconscious selection exercised by the micro-organism, the enzyme, or the previously existing asymmetric compound." Pasteur had himself pointed out that "to transform one inactive compound into another inactive compound which has the power of resolving itself simultaneously into a right-handed compound and its opposite, is in no way comparable with the possibility of transforming an inactive compound into a *single active* compound. This is what no one has ever done; it is, on the other hand, what living nature is doing unceasingly before our eyes." Here then is the conclusion to which, from a consideration of the facts of stereochemistry, Japp arrived: "The production of single asymmetric compounds, or their isolation from the mixture of their enantiomorphs, is the prerogative of life. Only the living organism with its asymmetric tissues, or the asymmetric products of the living organism, or the living intelligence with its conception of asymmetry, can produce this result." And further: "I see no escape from the conclusion that, at the moment when life first arose, a directive force came into play—a force of precisely the same character as that which enables the intelligent operator, by the exercise of his will, to select one crystallised enantiomorph and reject its asymmetric opposite." The action of such a directive force, moreover, involves no violation of the law of the conservation of energy.

An address on such a subject as that selected by Japp could not fail to provoke discussion, and its arguments were, indeed, assailed by Karl Pearson, Fitzgerald, Herbert Spencer, and others. All their criticism, however, was successfully met, and failed to force a retreat from any of the positions which had been taken up.

That the work which Japp accomplished for chemistry was appreciated by the scientific and academic world is shown by the honours of which he was made the recipient. As early as 1885, he was elected a Fellow of the Royal Society; from 1885 to 1891, he was Foreign Secretary, and from 1895 to 1899, Vice-President of the Chemical Society; in 1891, he was awarded the Longstaff Medal, the highest mark of appreciation which British chemists can show, for his researches in organic chemistry; in 1898, he was President of the Chemistry Section of the British Association; and from 1901 to 1904, he was Vice-President of the Institute of Chemistry. In 1888, the University of St. Andrews conferred on Japp the Honorary Degree of LL.D., and he was similarly laureated by the University of Aberdeen in 1915.

A sketch of Japp's scientific achievements, however, gives a picture of but half the man; for in him we find one who, although a specialist who won for himself high distinction in a relatively narrow field of scientific study, nevertheless appreciated and loved literature and art. A linguist of ability, the literatures of England, Germany, France, and Italy were accessible to him in the language of their authors; and while possessing a familiar knowledge of all that is best in the literature of our own country, his acquaintance with the literature of Germany, of France, and of Italy was such as might be envied by many who have taken up the study, not of science, but of letters. On many occasions an apt quotation or literary allusion gave point to an argument or brightened a conversation.

In his speech, as in his writing, Japp's language was always clear and accurate, and if he did not compose with rapidity he did so with exceeding care; and his writings were models of lucidity, logical development of an argument, and accuracy of expression.

Japp's interests extended, also, into the realm of Art, especially of music. A musician of cultivated taste, he possessed not only executive ability as a pianist but also a thorough knowledge of musical theory and a wide acquaintance with musical compositions. It was to him a great pleasure, relaxation, and recreation to spend an evening, in the company of music-loving friends, in discussing the compositions of his favourite composers or in performing their works.

Unskilled in the art of self-advertisement and indifferent to the world's estimates of eminence or wisdom, Japp looked upon the general activities of the world and the impatient hurrying of men with a certain Olympian detachment and philosophic calm; and the petty annoyances which were laid upon him by the jealousies or inconsiderateness of lesser minds he bore with amiable resignation. He was slow to form conclusions, but his judgment, whether of men or of opinions, was sound and could be relied on with confidence. He was himself the soul of honour and devoted to truth.

A product of the old *régime* in Arts in the Scottish Universities which, whatever its defects, cultivated width of view and diversity of outlook, Japp looked out on life through many windows, and to know him was in itself a liberal education.

In 1914, Japp retired from the Chair of Chemistry at Aberdeen and resided at first at Acton and later at Richmond, where he died. The closing years of his life were saddened by the loss of his son, who died, in 1920, while on the threshold of a promising career, from an illness contracted while on military service. In 1921, Japp's health broke down and he had to undergo an operation from which he never fully recovered; and in his last years, failure of eyesight deprived him of the companionship of books.

In 1879, Japp was married to Elizabeth Tegetmeyer, of Kelbra-Kyffhäuser, a small town near Nordhausen, by whom together with two daughters he is survived.

A. F.

---

## FRANCIS JONES.

Born 1845; Died October 22nd, 1925.

Francis Jones was born in Edinburgh in 1845 and was educated at the Edinburgh Institute and the University. He went to Heidelberg to work under Bunsen, and here he met Roscoe. On returning to England he became one of Roscoe's two assistants in the great work on the atomic weight of vanadium. For Roscoe he always expressed great admiration, but it was a disappointment to him that no acknowledgment of his help appeared in the great paper. He used to say, with a whimsical smile: "I was only referred to as Analyst A or Analyst B, I forget which." On the retirement of Dr. Marshall Watts, Jones was appointed chemistry master at the Manchester Grammar School. The High Master was then F. W. Walker, one of the few non-clerical headmasters at the time. Realising, as few of his confrères did, the possibilities of science as a means of education, he gave Jones a free hand, and success came at once. Scholarships at the older universities were offered for science, and Manchester secured a very large number. In 1879, no fewer than thirteen of these coveted distinctions were won by Manchester boys, probably a record for the science side of any school. There was no extra preparation for scholarship boys, either in physics or in chemistry. Both Jones and

John Angel, the physics master, believed in letting boys teach themselves and each other, and, beyond the formal lectures and a little instruction in the chemical laboratory, the masters left the boys to work out their own salvation. To a modern schoolmaster, the liberty allowed to the Science Sixth would seem incredible. Many an afternoon would be spent in the Manchester Free Library, or in the ever-delightful quietude of the fifteenth-century library of the Chetham Hospital near by.

Besides Jones's personality, what affected us boys most was seeing him always at work on research. Many of those who have since given their lives to original investigation, owe most of the impetus which has driven them on, to the work on boron hydride which they watched in progress. The complete destruction of a large charcoal stove in which boron trioxide was being heated with magnesium, and the carrying off of R. L. Taylor, Jones's collaborator, to the infirmary, were incidents which made an impression never to be effaced on those of us who saw it.

In the new laboratory at the top of the main block of buildings, Jones had at last a place worthy of himself. His special pride was a very large and well-ventilated draught cupboard. In this the writer attempted, in its first week, the isolation of the still unknown oxide of bromine. About 15 c.c. of liquid monoxide of chlorine were mixed with a quantity of dried silver bromide, and not only was all the frame work and glass shattered to pieces, but the 3-inch slate bed was broken. All Jones said, when he contemplated the wreckage, was : " Well, it was what it was made for."

He died, at the age of 80, on October 22nd, 1925. His memory will always be cherished by his old pupils, who were also his friends. No schoolmaster had an influence like his on the making of a chemist.

H. B. B.

## EDMUND KNECHT.

BORN JANUARY 29TH, 1861; DIED DECEMBER 8TH, 1925.

EDMUND KNECHT was born in Liverpool. His father, Gustav Knecht, B.Sc. (London), was a man of exceptional gifts as a schoolmaster, and his mother a Lancashire woman of singular charm. When Edmund was ten years old, the family settled in Southport, where his father conducted a school with much success for several years. From here the family, consisting now of three daughters and two sons, moved to the neighbourhood of Zurich, where a residential school was started on a largish estate. But the responsibilities and worries attendant thereon were too heavy and the

Knechts finally moved into Zurich itself. Edmund by this time was of an age to enter the University. He had natural leanings towards engineering, in fact his manipulative and mechanical skill was very marked. It was, however, his quick perception and interest in chemistry which attracted the notice of Victor Meyer, then Professor at Zurich University, and he induced Knecht to take up the study of this branch of science. At the age of twenty-one Knecht secured his Ph.D., his thesis being concerned with the homologues of resorcinol, and ultimately he became assistant to Victor Meyer. At this time Knecht saw a good deal of Sandmeyer, and the two remained all their lives the closest of friends.

Knecht soon after (1883) was offered the post of Head of the Chemistry and Dyeing Department of the Bradford Technical School which he occupied until, in 1890, there came a call to the Manchester College of Technology, in which institution he was actively engaged for the remainder of his life, as Professor of Tinctorial and Technological Chemistry, or as Associate Professor of Applied Chemistry of the University of Manchester. During a considerable portion of these thirty-five years Knecht was hard at work most days, including three evenings a week as well as Saturday afternoons. His influence on the students was remarkable both in the laboratories and in the lecture room. Few men of his time had so great a gift of inspiring their students with enthusiasm for their subject. Not only at home, but throughout the world, there must be thousands who have had the benefit of his tuition and his influence, and who regarded him with the utmost esteem both as a teacher and for his genial human qualities. His interest in his students did not stop with the conclusion of their academic career. He was wonderfully successful in finding them suitable posts, keeping track of them afterwards, and maintaining an interest in their future. Many are the chemists who would not hesitate to ascribe largely to Knecht's influence whatever success they have attained.

When the Society of Dyers and Colourists was formed in 1884, Knecht was appointed Editor of the Journal (1884—1893), which position he afterwards shared first with C. Rawson (1893—1899) and later with Professor W. M. Gardner (1899—1925). A large number of members assembled last year to commemorate the fortieth year of Professor Knecht's editorship and to make a handsome presentation to him subscribed to by his admirers, resident in all parts of the world.

The editing of the monthly journal just referred to claimed Knecht's close attention, but despite this he published in 1889 in conjunction with Benedict, " Chemistry of Coal Tar Colours," then in conjunction with Christopher Rawson and Dr. R. Lowenthal that very widely-known text-book, "A Manual of Dyeing," unique of its kind; another treatise, "The Principles and Practice of Textile Printing," was published in conjunction with J. B. Fothergill. Yet another publication is entitled, "New Reduction Methods in Volumetric Analysis," by himself and Eva Hibbert. Many of the new analytical methods described in this volume have been widely adopted in chemical works at home and abroad. The methods are specially applicable to the rapid volumetric estimation of a great variety of substances including iron, sugar, and many dyestuffs. Two editions of all these books have been printed. Knecht was a contributor of many articles to the "Encyclopædia Britannica" as well as to Thorpe's "Dictionary of Chemistry."

Knecht's original research work is recorded in some 120 papers in the *Journals* of the Society of Dyers and Colourists, the Chemical Society, and the Society of Chemical Industry, the *Berichte*, and elsewhere. An enumeration of the titles of all of them appeared in the first-mentioned journal in June, 1925, and February, 1926. His contributions to our knowledge of chemistry range over an extraordinarily wide field. Many are closely connected with industrial, others again with pure chemistry. The major part of his researches was in relation to the chemistry of dyes, to the theory of dyeing, and to the application and manufacture of dyes. But as a glance at the titles of his many papers will show, he gave particularly close attention to all matters connected with the chemical and physical properties of textile fibres, especially cellulose and its derivatives, and he published interesting researches on the constitution of soot, and French and American rosin.

Knecht's system of volumetric analysis by the use of titanous salts, originally only intended to be applicable to the estimation of organic dyestuffs, has been so widely extended as to cover analysis of a great variety of other organic, as well as inorganic, substances. The extraordinarily wide applicability of these methods of volumetric analysis are regarded by some as being of such great importance as even to overshadow his brilliant work on dyeing and the chemistry of cellulose.

Knecht's memory was prodigious and, having read widely, he kept himself well up to date in all that touched upon the chemistry of dyes and of dyeing and of textiles. In these domains he was a perfect walking encyclopædia and could refer one, with unfailing trustworthiness, to almost any source of information upon which one desired enlightenment.

Knecht's modesty was characteristic of so many truly great men; his heart was absolutely in his work, with little or no thought of personal advancement or financial benefit to himself.

The circle of his friends and admirers was a very wide one, although he was not much given to indiscriminate social activities. Probably he felt these might interfere too much with his always strenuous work.

As years advanced, Knecht's zeal and enthusiasm for his research work seemed to grow keener and more intense. This was true up to within a few weeks of his death. He then underwent two serious operations. From the effects of these he had not quite recovered when in December, after two months spent in Switzerland, he returned home in very trying weather conditions, as a result of which he quickly succumbed to an attack of bronchitis and, his heart being unable to withstand the further strain, he breathed his last at Marple in the county of Cheshire, where he had made his home for so many years.

I can say without hesitation that I have rarely come across a man who so well deserved the esteem and affection and gratitude of a great body of chemists. A host of them owe to Edmund Knecht that sound basis of scientific thought and enthusiasm for their subject without which so little can be accomplished that is truly worth while in the domain of chemistry. He did his best in his own special sphere of activities and none will deny that his best was very good.

ALFRED RÉE.

---

## WILLIAM ROBERT LANG.

BORN 1870; DIED NOVEMBER 20TH, 1925.

THE late William Robert Lang was a graduate of the University of Glasgow (B.Sc. 1890, D.Sc. 1899) and resigned the lectureship in Organic Chemistry there to become Professor of Chemistry in the University of Toronto. He was a Fellow of the Chemical Society (1897) and a member of the Institute of Chemistry and was elected Fellow of the Royal Society of Canada in 1911.

One of Dr. Lang's first activities in Canada was the promotion of a Canadian Section of the Society of Chemical Industry, of which he was the first Chairman. His scientific interests lay chiefly in the application of chemistry to industrial problems, and his monograph on the chemical industries of the Dominion (*Trans. Can. Inst.*, 1905) formed the basis of the "Directory" published by the Canadian Government in 1921. Many other papers in the chemical journals bear his name, or the names of his students.

From 1889 until the day of his death, Dr. Lang was actively connected with the forces of the King. In Glasgow, his birthplace (1870), he served with the Lanarkshire Royal Engineers (Volunteers); the year of his arrival in Canada he was gazetted to the Second Field Company Canadian Engineers, which he commanded as Major (1902) and Lieutenant-Colonel (1912); at the coronation of King George V in 1911 he commanded the Canadian Infantry there present. On the outbreak of war in 1914 he was appointed to the Canadian General Staff, assumed the duties of Officer in Charge of military instruction for Military District No. 2, and became O.C. the University of Toronto contingent of the C.O.T.C. In 1917 he was gazetted Colonel, and in the following year was G.S.O. (1) Coast Defence in the Maritime Provinces at Halifax N.S.

At the close of the war, Colonel Lang resumed command of the reorganized C.O.T.C. contingent, and resigned the professorship of Chemistry to direct the Department of Military Studies newly established in the University of Toronto; to the excellence of his work in this capacity high tribute was paid by Major-General MacBrien, Chief of Staff of the Canadian Militia, and a very keen critic, when at last year's inspection he said: "This is the largest O.T.C. inspection I have ever seen—and also the best."

Dr. Lang died very suddenly on November 20th last; the military funeral was preceded by a service at the University.

W. Lash Miller.

---

## FRANK GEORGE POPE.

Born November 13th, 1867; Died October 29th, 1925.

Frank George Pope was born on November 13th, 1867, the son of George Campion Pope and Teresa Pope. He received his early education at Haberdashers' School and afterwards proceeded to Finsbury Technical College with the intention of becoming an engineer. This intention was not realised, as he went to the Peoples' Palace Technical Schools as a demonstrator in the Chemical Department. At that time, East London College had not been thought of, and it was necessary to deal, not with matriculated students working for a degree, but with boys of 12 to 15 years of age belonging to a large day school and to spend four nights a week on evening classes, principally attended by junior works chemists and elementary teachers. Luckily, no classes were held on Saturdays.

When I first met Pope one evening in February, 1894, he was running a practical class of the stamp usual in those days and trying to do some research in the store-room, as he had no private bench of his own at which he could work. The next month we joined forces and started a firm friendship which only ceased with his lamented death last October. Had it not been for his help, kindness, and extreme loyalty, my earlier days at the People's Palace would have been very different. Pope could manage boys; not being used to them, I could not. His methods were summary but just, and many an old boy must remember the penalties exacted for not taking down notes properly during lecture. Whilst boys had to work hard and keep the peace when in class, once the week's work was done, Pope would play cricket with them on Saturdays and for years attended the annual camp of Day School boys on the South Coast.

Pope very soon joined in some work that was interesting me; this was kept going at odd times between classes and, on Saturdays, we often met about 2 p.m. and went on until 10. Our earliest joint publications were concerned with fluorones, the "abnormal hydrates" formed by hydroxyazo-compounds and one or two new hydrazines. The fluorones especially interested Pope and he returned to their study in later years, his work (partly with H. H. Howard) and that of Kehrmann clearing up many doubtful points.

In the later 'nineties, the nucleus of East London Technical College was formed with a number of day boys who had finished their three or four years' course and could be put on to more advanced work; in this way, a supply of research assistants was at last assured. Meanwhile, Principal Hatton was striving for the establishment of an East London College. Such a college has now been a school of the University of London for some years past.

A good knowledge of organic chemistry and great interest in the subject, together with a genial disposition, made Pope an excellent teacher. After an advanced organic lecture, he would come with the class into the laboratory, walk to a blackboard, start asking questions, expound views, and make the students show what they did or did not know.

From 1915, until the chair of chemistry was filled by the appointment of Professor Partington, Pope acted as head of the Chemical Department, and the College authorities made him an Assistant-Professor. He had been a Reader in the University for some years. The burden during the war was considerable and the subsequent work heavy, as East London College, like other institutions, suffered from a surfeit of students.

During a well-earned holiday in 1922, peritonitis supervened on food poisoning and after an operation in Switzerland it was some months before Pope returned to England. For a time, he continued his work at East London College, but it was evident that his health was broken and he had to retire in 1923. His old students and colleagues made him a presentation at the Old Students' Association dinner in January, 1925. This was the last College function he attended. After further months of illness, he died on October 29th, 1925.

Pope was beloved by his pupils and colleagues. Students who shirked or exhibited too much conceit had reason to regret their faults, but anyone who desired aid found in him a ready helper. Like many other chemists, he enjoyed out-door life and it was a delight to sit with him on a Surrey hill, not bothering about the time of lunch or the return train to London.

He married Adelaide, daughter of Harold Field Downer. She and a married daughter survive him to mourn his loss. His old students and former colleagues remember a very unselfish friend to whom they owed many a debt for uniform kindness and consideration. No one realises this more fully, or holds his memory in deeper affection, than the present writer.

J. T. HEWITT.

## CHARLES ETTY POTTER.

BORN JANUARY 5TH, 1880: DIED SEPTEMBER 13TH, 1925.

CHARLES ETTY POTTER was born on January 5th, 1880, at Melsonby, near Darlington, at which place his father was headmaster of the Wesleyan school. An early aptitude for school work enabled him to gain a Flounder's scholarship with which he entered the North Eastern County School at Barnard Castle, and a successful school career was terminated by the winning of a North Riding scholarship tenable at the Yorkshire College. In his studies at Leeds, Potter's attention was directed to the physical sciences, and after graduating as B.Sc. of Victoria University in 1900, he pursued a post-graduate course in applied chemistry under Professor H. R. Procter in the leather industries department. In the development of various social activities at the Yorkshire College, Potter took a very active part, and the students' scientific, debating, and other societies were indebted in no small measure to his energy, enthusiasm, and determination.

On leaving the Yorkshire College in 1901, Potter accepted a post on the research staff of the Wellcome chemical research laboratories, where, for some years, in collaboration with Dr. F. B. Power and Dr. H. A. D. Jowett, he was engaged in the investigation of problems connected for the most part with complex organic compounds. Three papers published in the *Journal* of the Chemical Society conjointly with H. A. D. Jowett, namely: "Preparation and Properties of 1 : 4(or 1 : 5)-Dimethylglyoxaline and 1 : 3-Dimethylpyrazole" (J., 1903, **83**, 464), "The Constitution of Chrysophanic Acid and of Emodin" (*ibid.*, p. 1327), "The Constitution of Barbaloin" (J., 1905, **87**, 878), indicate the nature of the work on which he was engaged. The *Pharmaceutical Journal* affords a record of other work with which Potter was associated during this period.

In January, 1906, Potter was transferred to a position in the analytical department at the Dartford works of Messrs. Burroughs Wellcome and Co., but towards the end of the same year he decided to take up teaching work. For a short time he was engaged at the Abergele Council school, but his chief teaching work was done at the Heckmondwike Secondary school where for 10 years he was engaged in teaching chemistry, physics, and mathematics and was responsible for the organisation of courses of instruction in physical science adapted to the requirements of a scheme of home training for girl pupils. For the greater part of this period he was also in charge of evening chemistry classes at the Batley Technical College. Early in 1916, he obtained an appointment as research chemist with Messrs. Levinstein, Ltd., at Blackley, Manchester, which position he retained after the amalgamation of Messrs. Levinstein with British Dyes, Ltd., and at the time of his death he was in the service of the British Dyestuffs Corporation, Ltd. As a member of the staff of the technical research department in this concern Potter was not only associated with the laboratory research work on colouring matters, but with problems incidental to large-scale production; he also held a position of considerable responsibility in connexion with the engagement and welfare of chemical assistants in the technical departments. He took a keen interest in the activities of the Manchester sections of the Society of Chemical Industry and the Institute of Chemistry, and served on the Committee of the latter for a period of three years.

Many of his Yorkshire friends had an opportunity of meeting him at the annual meeting of the Society of Chemical Industry at Leeds in July, 1925. Those who took part in the excursion to Huddersfield were particularly impressed by the lively and illuminating manner in which Potter explained certain of the processes carried on in the works of the British Dyestuffs Corporation. Towards the end of the same month he became seriously ill as the result of an insect bite on the scalp, and, in spite of every attention, died in the Manchester Royal Infirmary on the 13th September, and was buried in the grounds of St. Margaret's church at Prestwich on September 16th. He left a widow and three sons of school age.

For information relating to Potter in the period subsequent to his University studies, the writer is much indebted to Mr. F. H. Lees, the Head of the analytical department of Messrs. Burroughs Wellcome and Co. Potter is described by him as an enthusiastic worker, exhibiting unusual initiative and resourcefulness in overcoming the difficulties inseparable from original research. His cheerful disposition never deserted him under the most trying conditions and his relations with his colleagues were of the most cordial kind. He always strove to uphold the traditions of his Alma Mater and often became eloquent in insisting upon how much he was indebted to his chemical teachers at Leeds. The characteristics portrayed in this description would appear to have been retained in undiminished measure in the later period of his life, and his fellow chemists deplore the loss of a colleague whose integrity and sincerity were universally acclaimed.

H. M. Dawson.

---

## ROBERT LLEWELLYN TAYLOR.

Born November 21st, 1851; Died November 8th, 1925.

One of the pioneers of the teaching of science in this country and a man of high scientific attainments, R. L. Taylor passed away at his home in Whalley Range, Manchester, after a sudden heart attack. He will be sadly missed by many friends and associates, who welcomed a meeting with Taylor as one of their real pleasures. Always enthusiastic in the pursuit of chemical knowledge, of a cheery and kindly disposition, he carried a warm atmosphere about with him.

Taylor was born at Sabden in the Pendle Hill district and as a boy he attended the village school there. At fourteen years of age, he was employed at the print works at Sabden, of which his father was the manager. His parents originally intended that he should learn the business of a calico printer and during four years he spent the daytime in this way. In the evenings he studied the science of chemistry and fitted up a disused room in the works as a chemical laboratory. The course which he followed was no easy one, for he had no teacher, but it was at the same time a fine training ground, because it enabled him to understand the difficulties of others when in later years he became a teacher. After his four years' work at Sabden, he was appointed lecturer's assistant to Dr. A. W. Williamson, Professor of Chemistry at University College, London. Here Taylor made the most of the fine opportunity which presented itself of acquiring skill in experimental and research work. In 1872 he was appointed assistant master in the chemical laboratory of the Manchester Grammar School and in this position his teaching ability soon made itself manifest. Taylor was associated with Mr. Francis Jones at the Grammar School in the discovery and investigation of boron hydride and the work was published in the *Journal* of the Chemical Society. In 1878, Taylor became teacher of chemistry and physics under the School Board and later he became organising master and inspector of science classes to the Manchester Education Committee. The work from 1880 to the date of his retirement under the superannuation act in 1919 involved both day and evening class duties. In spite of this, he managed to find time for many original investigations and his pupils could realise that they were receiving not merely book lore, but first-hand knowledge from one who worked for the love of science. His research was not made easy by the possession of a well-equipped chemical laboratory and he was always grateful for the encouragement of friends and for the assistance afforded by the loan of some simple piece of apparatus. The records of some of his work appear in the *Transactions* of the Chemical Society, in the *Journal* of the Society of Dyers and Colourists, and in the *Memoirs* of the Manchester Literary and Philosophical Society. They embrace a very exhaustive study of bleaching powder and its action in bleaching, the action of bleaching powder on various natural colouring matters, the effect of light on solutions of bleaching powder, a comparison of the bleaching action of hypochlorous acid and chlorine, and a method for the determination of chloric acid and chlorates. In 1911 he was awarded the research medal of the Worshipful Company of Dyers. In earlier years, Taylor introduced a method for the separation of cobalt and nickel and carried out work on a higher oxide of cobalt and on white ferrous ferrocyanide. His chemical text-books are widely known and include "Analytical Tables for Chemical Students," "Chemistry for Beginners," "The Student's Chemistry," and "Chemistry for Evening Continuation Schools." In 1922 Taylor issued and edited a small book, entitled "Bleaching Powder and its Action in Bleaching," embodying his original memoirs on the subject of bleaching powder.

Many distinguished scholars owe their first inspiration to the teaching and guidance of Taylor. In addition to his scientific attainments, he was able in his leisure hours to provide entertainment for old and young by his lectures and demonstrations such as those on soap bubbles and methods of obtaining a light. With a lively party of boys he would explore the wonders of Castleton, the beauties of Ingleton, and the mysteries of Whalley. His interest in the subject of sound extended still further his love of music and he conducted an orchestra in the Central High School in Manchester.

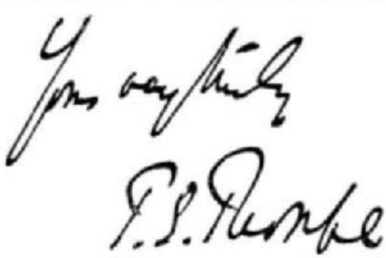
There is a vacant place in the Manchester Literary and Philosophical Society, of which he was a member of the Council. He was a member of the Chemical Society from January 1874 until the date of his death. [The late] EDMUND KNECHT.

---

## SIR EDWARD THORPE.

BORN DECEMBER 8TH, 1845; DIED FEBRUARY 23RD, 1925.

IN the death of Sir Edward Thorpe, which took place at Whinfield, his residence at Salcombe, South Devon, on February 23rd, 1925, in his eightieth year, the Chemical Society lost a former President, whose membership extended over 54 years, and who during this period served the Society as Member of Council, Vice-President, and Treasurer for ten years, from 1899—1909. The record of Sir Edward Thorpe's activities and achievements in chemistry is a full and varied one. Successively he filled with distinction and success the Chair of Chemistry in three institutions. He was appointed to the Andersonian College, Glasgow, in 1870, having as forerunners Birkbeck, Gregory, and Graham, "an honourable and distinguished ancestry," of which he was justly proud. Then in 1874 Thorpe was appointed Professor of Chemistry in the newly-founded College at Leeds, the Yorkshire College of Science, as it was at first styled, the second of those provincial colleges which owed, in no small measure, their formation to the stimulus which the success of Owens College, Manchester, had given to the movement for the provision of university education in the provinces. This appointment must have appealed especially to Thorpe, himself a first and one of the best products of the provincial university college, affording, as it did, opportunities of putting into practice the system of educative work of which he had had experience in the years spent at Owens College. At that time (1873) Owens College had just emerged from its temporary housing to occupy the first block of buildings on the present site of the University of Manchester. Thorpe was fortunate in having as colleagues men so distinguished as Green, Miall, and Rücker, with whom he laid the foundation and traditions of an institution from which the University of Leeds has grown. When in 1885 Thorpe resigned the post at Leeds to become the successor of Sir Edward Frankland at the Royal College of Science in London, he had the satisfaction of seeing the Yorkshire College housed in new and appropriate buildings, with well-designed and equipped chemical



[*To face p.* 1031.]

laboratories and lecture theatres. In the year 1894 he was appointed the Director of the Government Laboratories and was responsible for their design and equipment. Shortly before his retirement, in 1909, he accepted the invitation to resume the Professorship of General Chemistry at the Imperial College of Science and Technology, which had been formed by the amalgamation of the Royal College of Science and the City and Guilds Institute at South Kensington. This position he finally resigned in 1912.

The discharge of the duties of these various positions, and the demands made on his time and energy in the building up of a new college at Leeds, did not prevent Thorpe from maintaining a steady output of scientific investigations and research. Furthermore, throughout his life, he maintained a literary activity; the volume of collected essays on Historical Chemistry, the memorial lectures on Kopp, Victor Meyer, Cleve, and Thomson, as also the articles on scientific worthies contributed to *Nature*, constitute examples of the highly valuable additions made to chemical literature and afford illustrations of the clearness in style and the extensive knowledge which characterised his writings. Thorpe's interest in the history of chemistry is shown by the selection of subjects for addresses. At the Leeds Meeting of the British Association in 1890, Priestley, Cavendish, Lavoisier, and *La Révolution Chimique* formed the subject of the address delivered to Section B (Chemistry) on that occasion; and again, ten years later, he selected for the Presidential Address to this society "The Progress of Chemistry in Great Britain and Ireland during the Nineteenth Century." Further, among other valued contributions to chemical literature are the biographies of Priestley, Davy, and of his teacher, Roscoe.

In more prosaic fields, mention should be made of his text-book of Inorganic Chemistry, published in two volumes, the text-books of quantitative and qualitative analysis, and of the monumental work, "The Dictionary of Applied Chemistry," the preparation of a new and enlarged edition of which occupied him to within a few weeks of his death.

Thomas Edward Thorpe, the son of George Thorpe, a Manchester merchant engaged in the cotton trade, was born on December 8th, 1845, at Barnes Green, Harpurhey, near Manchester. His early education he received at the Manchester Diocesan School (Hulme Grammar School), and in 1863 he entered Owens College as a student in the Chemical Department under Professor Roscoe. Here he remained for four years, acting for the greater part of this period as private assistant to Roscoe, taking an active part in the photochemical researches, the investigation of perchlorates, and in the classical work on vanadium, which ultimately resulted in assigning to this element its true position in the classification of the elements. In the obituary notice of Sir Henry Roscoe, Thorpe has given an account of much of the work of this period, and in connection with the vanadium investigation he wrote: "It was the writer's privilege to assist in the early stages of this investigation, and it fell to his duty to carry out the various experiments which eventually served to establish the composition of the oxides of vanadium, the true nature of its volatile chlorides, the existence of hitherto unknown oxychlorides, and of the mononitride which Berzelius regarded as the metal, and lastly to fix its real atomic weight and to show that it was apparently 16 units below that assumed by Berzelius on the mistaken supposition that vanadium compounds were analogous in composition to those of chromium."

In connexion with the photochemical researches, Thorpe journeyed in 1866 to Pará on the Amazon, and in the autumn of 1867 he made a long series of observations under a cloudless sky at Moita, near Lisbon, concerned with the relation between the sun's altitude and the chemical intensity of daylight. It was on the return journey from Pará that he made a series of determinations of the carbon dioxide present in the air over the ocean, and succeeded in establishing a constancy in the daily and nightly proportion of 3 volumes of carbon dioxide per 10,000 volumes of air, thus confuting the conclusions drawn by Lewy, who maintained that the proportion of carbon dioxide in the air over the ocean exhibited a diurnal and nocturnal variation. In recognition of this work Thorpe was awarded the Dalton Scholarship in Chemistry.

Mr. J. Kentish Wright of Nottingham, a fellow student and life-long friend of Thorpe, has furnished the writer with the following recollections:

"I first came into intimate association with Thorpe (then universally known as Tom Thorpe) in the year 1865 when we were both students at Owens College, Manchester, and were elected joint Secretaries of the Students' Union. Previous to this I had only known him slightly, as he was entirely a 'science' student, and I was entirely an arts student; as far as I remember, we never attended the same lectures but were constantly meeting on union matters; we soon found we had many tastes and interests in common. He was widely read in modern literature and had a very keen appreciation of Dickens and Thackeray, and we had many talks as to our favourite novels. His distinguishing characteristic was his extraordinary vitality and energy, which he put into whatever he was occupied with, and which enabled him to excel in whatever he undertook. Of his eminence in science I was then and am now unable to judge, but the distinction he attained is sufficient evidence of this. He was, moreover, a skilful writer of popular sketches and verses, which appeared in the Students' Magazine, and was the author of a very interesting account of the rubber gatherers of South America.

" He had a very strong sense of humour and love of fun, was an excellent story-teller, and could enjoy a joke against himself.

" He was an ardent sportsman and lover of athletics, and took a very active part in originating the boat races, which were rowed on the Irwell between the Science and Arts students. These were started in 1864 and continued for many years. He coxed and coached the Science boat, and on one occasion, although of small stature, he rowed bow in that boat.

" He was also a keen cricketer and a useful bat, playing regularly for the college eleven.

" About this time he introduced me to the young lady (Miss Emma Watts, daughter of Dr. John Watts) to whom at that early age he was engaged and to whom he was devoted the whole of his life. They were married in 1870, at the Manchester Cathedral, and I was present as one of his groomsmen. Lady Thorpe is now living at his beautiful home at Salcombe, South Devon.

" In later years his great pleasure was yachting, and he has written several books describing his cruises. It was soon after he went to Glasgow (about 1871 or 1872) that he bought a small cutter yacht and invited me to go with him on a cruise to the Hebrides. I was terribly disappointed that I could not accept, but subsequently I had reason to congratulate myself. Thorpe sailed the yacht up to Skye and anchored off the coast there—but the wind got up in the night—the anchors dragged and the boat was driven on the rocks and became a complete wreck. There was a small dingy and in this Thorpe and his brother-in-law, Harry Watts, and the two men forming the crew managed to reach the shore. If I had been there, in all probability the dingy would not have carried all and there would have been a tragedy. They spent the night shivering on the rocks, and in the morning found themselves in the most desolate part of Skye—eight miles from the nearest house.

" Although our paths diverged in after life, we kept up our friendship to the end of his life by correspondence and occasional visits. It was always an unfailing delight, when we met, to recall the old days and to tell over again the old stories and reminiscences. The last time I saw him was in the year 1921, when he stayed a few days with me on his road to Edinburgh for the British Association Meeting. Thorpe told me an amusing story about Lloyd George, whom, by the way, Thorpe much resembled in stature and appearance, and for whom he was often mistaken. Lloyd George, when Chancellor of the Exchequer, wished to put a tax on petrol or other spirits used for motors, and sent for Thorpe, who was then Government Chemist, to obtain the proper word to comprise petrol, benzoline, paraffin, and anything else used for that purpose. Thorpe disapproved of the proposed tax, and determined not to help Lloyd George. He said, 'There is no one in England knows more about it than I do, and I can't find a word, and if I can't, no one can.' Lloyd George jumped up and ran to Thorpe and seized him by the lapels of his coat and shook him vigorously, saying, 'Look here, you can help me and you've got to help me—you can help me and you've got to help me.' Thorpe went away quite won over by Lloyd George's fascination and powers of persuasion. He spent a sleepless night pondering the problem, and with the dawn there flashed across his mind the phrase 'Motor Spirit,' which was accepted and has been in use ever since."

In *The Old Owensian Journal* for May, 1925, appeared an appreciation of Sir Edward Thorpe from the pen of the late Francis Jones, who wrote as follows :

"It was my good fortune to make the acquaintance of T. E. Thorpe in 1866 when I returned from Bunsen's laboratory in Heidelberg to become private assistant to Professor Roscoe in the Old Owens College in Quay Street.

"The Professor told me that he had obtained from the copper works at Alderley Edge a large quantity of a residue containing about 2% of vanadium, and he wished to make an investigation of the properties of that rare element and its compounds. He asked me to work at this along with T. E. Thorpe, who had been a senior student of the College, and I was soon after introduced to him. Thus began a lasting friendship between us, and for many months we worked together on what was to both a most fascinating research. We soon found out that what Berzelius considered metallic vanadium was really the lowest oxide, and this involved the lowering of its combining weight to 51·2. It was impossible to work in daily association with Thorpe without being attracted by his unfailing cheerfulness, genial humour and intimate knowledge of chemistry. The results obtained in the investigation were communicated by Roscoe in a paper read before the Royal Society. Our close association ended in 1867, when Thorpe went to Bunsen's laboratory, and soon after (1870) he became Professor of Chemistry in the Andersonian Institution in Glasgow, but we continued to meet from time to time and kept in touch with each other by correspondence.

"He helped me greatly in 1911 when I started a movement to celebrate the centenary of Bunsen's birthday by sending an illuminated address and wreaths to the Pro-Rector of Heidelberg University, Professor von Duhn, who requested Bunsen's successor, Professor Theodor Curtius, to acknowledge the address and wreaths which were forwarded to Heidelberg in time for the celebration of the anniversary on March 31st, 1911.

"Professor Curtius wrote: 'The address will be framed and find its place in the Bunsen Room of the Chemical Institute with the picture and other mementos of the Master.' Thanks to Thorpe's help twenty-three former students of Bunsen's added their names to the address; these included Henry E. Roscoe, 1852—1855, Alex. Crum Brown, 1861—1862, W. Marshall Watts, 1865, Francis Jones, 1865—1866, T. E. Thorpe, 1867—1870, C. A. Burghardt, 1870, W. Carleton Williams, 1871—1872, J. Grossmann, 1872—1873, Arthur Schuster, 1872, Arthur Smithells, 1883, and G. H. Bailey, 1884—1885.

"I last saw Thorpe when he was President of the British Association in Edinburgh, when he was unfortunately unable, owing to illness, to be present at most of the meetings."

As has been already mentioned, Thorpe obtained the Dalton Scholarship in Chemistry and then proceeded to Heidelberg to study under Bunsen. The following is an extract from a letter published by Sir Henry Roscoe in his Autobiography from Thorpe in which he describes incidents of his arrival at Heidelberg and his reception by Bunsen:

"Well, in the autumn of '67 I set out for Germany, fortified with much good advice, and bearer of sundry presents from you and yours to Bunsen—among them a copy of *The Times* containing an account of a 'horrid murder' (you remember the dear old man's amiable weakness for 'horrid murders'), a small consignment—I think from Mrs. Roscoe, your mother—of potted shrimps (another amiable weakness), and above all some magnificent specimens of potassium and sodium (calculated to go straight to his heart) from Mather's works at Patricroft. Sonstadt had worked out Caron's process for the manufacture of magnesium, and there was what we then considered a great demand for the metals of the alkalis.

"After a leisurely journey up the Rhine—I remember seeing the white-coated Croats in garrison at Mayence—I found myself in Heidelberg and lost no time in presenting myself to Bunsen, armed with the copy of *The Times*, the potted shrimps, and the precious box containing the alkali metals. Although it was still vacation time, Bunsen had returned to work. I was ushered into the little room you know so well, overlooking the Wrede Platz. The great man—great physically as well as intellectually—rose from the table at which he was writing—I see him now—and motioned me to the sofa. He evidently was not unprepared for my coming—I suppose you must have informed him. I duly presented your letter of introduction and, after answering his many tender inquiries concerning you, moved up my heavy battalions. I received a momentary check, however, for owing partly to his slight deafness but much more to my imperfect knowledge of German, he moved across to the sofa the better to hear me and sat down on my hat! I at once brought *The Times*, the potted shrimps, and the alkali metals into action. The 'horrid murder' he would read at bed-time: the potted shrimps would certainly be appreciated in the morning: and we prepared ourselves for the alkali metals. The servant was called to unpack the box, when to my consternation he produced a bottle—I remember it was an old pickle-bottle—partially filled with naphtha, at the bottom of which were a few tablespoonfuls of a bright shining rather mobile fluid. I had given the Geheimrath such a glowing account of the size of the sticks of the two metals that I was simply speechless with astonishment and felt indeed rather like an impostor. I had never realised so vividly before the possibility of the transmutation of metals. 'Well,' I said at last, 'potassium and sodium were certainly put into the bottle before I left home, but what is there now is uncommonly like quicksilver.' 'No,' said Bunsen, who was holding the bottle, 'it is not quicksilver. Feel the weight of it!' The fact was that our old friend Heywood, who had been ordered by you to pack the specimens at the time in separate bottles, perceiving that both could be got into one bottle, had, with the charitable idea of not encumbering me with too bulky a package, placed the two metals together, with the untoward result I have indicated. Chemical combination between solids is not of frequent occurrence, but that it is possible under certain circumstances has never been forgotten by me. I had no knowledge at the time of the existence of the fluid alloy—nor had Bunsen—which, perhaps, is not very creditable to us, since it is actually mentioned by Davy. As an historical fact, I believe the first so-called potassium isolated by Davy was fluid at ordinary temperatures owing to the amount of soda in the electrolysed potash.

. . . . . . .

"I assure you I felt a little limp at the moment—more limp, indeed, than my crushed hat—and, conversation flagging, he suggested that he should show me the place where he intended that I should work. It was in his own little laboratory, a couple of benches away from him, and where I had as companions Victor Meyer and an American—Gideon Moore—a man of extraordinary ability, who had the misfortune to be stone-deaf, but who taught himself German and spoke it fluently without having heard a sound of the language."

Thorpe's memorial lectures on Kopp and Victor Meyer enable us to gather something of the impressions made by the life and work at Heidelberg. His fellow students included many whose names are writ large in chemical literature, *e.g.*, Erlenmeyer, Ladenburg, Horstmann, Ludwig, Cohen (the mineralogist), Rose, and Emmerling. Thorpe was undoubtedly greatly attracted to Kopp, whose influence and teaching are to be seen in his own researches on specific volumes and other physical constants, remarkable for their exactitude.

At Heidelberg he graduated as Ph.D., and during this period he published papers dealing with (1) nontronite, to which he assigned the formula $Fe_2O_3,3SiO_2,5H_2O$, (2) the analysis of the ash of a diseased orange tree, and (3) observations on the physical properties of chromium oxychloride, directing attention to the identity in the molecular volumes of sulphuryl chloride ($SO_2Cl_2$) and chromium oxychloride ($CrO_2Cl_2$). From the latter he obtained, by the action of heat, the solid oxychloride of chromium–chromium chlorochromate, $Cr_3O_6Cl_2$.

From Heidelberg Thorpe went to Bonn, and whilst there, worked with Kekulé on ethylbenzoic acid, which they isolated from the product of the action of carbon dioxide on sodium and an ethereal solution of ethylbromobenzene.

Returning to Manchester he joined, for what proved a short period, the teaching staff of the chemical department at Owens College, and in 1870 he was appointed Professor of Chemistry at the Andersonian College, Glasgow. Here the association with Young, the founder of the Scottish oil industry, led to the study of paraffin, and in conjunction they conducted a research on the action of heat and pressure on paraffin, which formed the subject of two papers. The authors noted but little gas to be produced, and from 4·5 kilograms of paraffin they obtained 4 litres of liquid hydrocarbons, which were separated into 2·7 litres boiling at 200—300°, 1 litre boiling at 100—200°, and 0·3 litre boiling below 100°. From this last fraction both amylene and hexylene were isolated.

Whilst at the Andersonian College Thorpe attempted, in the light of his experience with vanadium oxychloride, to prepare a lower oxychloride of phosphorus by submitting phosphorus oxychloride to the action of reducing agents, but found the phosphorus compound to behave quite differently, yielding phosphorus trichloride only, and giving no indication of the formation of oxychlorides similar to those of vanadium. The production of phosphoryl thiochloride by the interaction of phosphorus pentasulphide and carbon tetrachloride was noted. The determination of the solubility of silver chloride in concentrated nitric acid led to the conclusion that this solubility is of the order of 2 parts of silver chloride in 100,000 parts of concentrated nitric acid. During the tenure of the professorship at Glasgow Thorpe published the text-books already referred to: (1) Inorganic Chemistry, in two volumes (Collins), (2) Quantitative Analysis (Longmans), and (3) Qualitative Analysis; in the production of this last M. M. Pattison Muir collaborated.

The translation to Leeds took place in 1874, when Thorpe was appointed Professor of Chemistry in the Yorkshire College of Science, with A. W. Rücker in the Professorship of Experimental Physics (with which was associated Mathematics) and A. H. Green in the Professorship of Geology and Mining. In the biography of Sir Henry E. Roscoe, Thorpe gives a sketch of the history of the foundation of the Yorkshire College, from which may be gathered some idea of the conditions under which a beginning was made. He writes:

"The premises in which the College was first housed consisted of a disused Bankruptcy Court situated in Cookridge Street, one of the main thoroughfares leading out of the town. After a somewhat chequered career, the building had been partially used as a school of cookery, with the unfortunate result that it had been largely consumed by a fire just prior to being taken over by the College authorities. Although not so spacious as Richard Cobden's old house in Quay Street, Manchester, in which Owens College first started, the Leeds building, in some respects, was not ill-adapted to the purposes of the limited professoriate with which the Yorkshire College of Science began its operations. At all events, it accommodated without the slightest difficulty all the students who sought admission to it on its opening day.

"The College began its work of teaching on October 26th, 1874—somewhat later than the normal opening of a session—owing to delays in completing the necessary structural arrangements. But as there was no yearning anxiety on the part of anybody to learn, no special inconvenience or disappointment resulted. There was no preliminary flourish of trumpets—hardly so much as an opening speech. The initial ceremony was as simple as the appointments of the College were modest. Each of the three professors in turn gave an introductory lecture to an audience consisting of members of the Council and such of the friends of the embryo institution as cared to attend. Some encouraging remarks were made by the Chairman, and so the College was launched. But for a time the students were few and their advent as far between as the visits of angels."

Unless one has had the like experience, it is not easy to realise what the first years of such pioneering work meant and entailed. However, the work evidently progressed, as in 1877 the foundation stone of the new College buildings was laid, and before this the professoriate had been extended by the appointment of Professor L. C. Miall to the Chair of Biology, and later the establishment of Chairs of Classical Literature and History, and Modern Literature and History, to which Professor J. Marshall, M.A., of Balliol College, Oxford, and Professor F. S. Pulling, B.A. (Oxon), were, respectively, appointed. "This enlargement," Thorpe writes, "of the educational work of the College necessitated a slight but significant change in its designation: henceforward it became known as the Yorkshire College until it was raised to the rank of a university, when it took the name of the town in which it was situated."

The eleven years spent at Leeds were marked by a steady output of scientific work, and this despite the many and varied demands upon Thorpe's time and energy necessitated in establishing the new College. Amongst the researches of this period, researches marked by the accuracy characteristic of all Thorpe's work, are those concerned with the specific volumes of liquids. He was led to conclude from the specific volumes of phosphorus oxychloride and thiochloride that in these compounds phosphorus functions as a tervalent element, thus giving support to the formula $\begin{matrix}Cl\\Cl\end{matrix}\!\!>P{-}O{-}Cl$ in preference to the formula $\begin{matrix}Cl\\Cl\\Cl\end{matrix}\!\!>P{=}O$, necessitating a quinquevalent phosphorus. A few years later Thorpe was destined to provide evidence in support of the higher valency for phosphorus, by the discovery of the gaseous pentafluoride, as a product of the interaction of arsenic trifluoride and phosphorus pentachloride. The physical properties of this compound afforded a ready means of fixing its molecular weight, which with its analysis showed the molecular formula to be $PF_5$.

In a lecture to this Society, Thorpe, in 1880, gave an account of his work "On the relation between the molecular weights of substances and their specific gravities when in the liquid state." In recognition of the value of these researches he was awarded the first Longstaff Medal in 1881. Professor Roscoe, the President, in making this presentation, expressed himself as follows:

"Professor Thorpe: I consider it a special privilege that it falls to my lot to present to you, as one of my oldest and most distinguished pupils, the first Longstaff Medal awarded by the

Chemical Society for the best series of original investigations in chemistry published in England during the past three years, amongst which I may mention, as the most important, your discovery of phosphorus pentafluoride; that of the occurrence of heptane in *Pinus Sabiniana*, giving accurate determinations of its physical constants; and, last, the valuable contributions to Physical Chemistry in your researches on the relations between the molecular weights of substances and their specific gravities when in the liquid state. I trust that this recognition by the Chemical Society of your varied and successful labours will stimulate to further efforts, and that before long the Society may be benefited by other communications from your laboratory."

Amongst the communications from the laboratory of the Yorkshire College are to be found: "A Simple and Expeditious Method of Preparing Pyrogallol for Dry Plate Development"; "The Action of Zinc, Magnesium, and Iron as Reducing Agents with Acidulated Solutions of Ferric Sulphate"; "Note on the Action of the Oxychloride of Sulphur on Silver Nitrate"; "Contributions to the History of the Mineral Waters of Yorkshire"; and "On Dust Explosions in Collieries." Further, the re-determination of the atomic weight of titanium was made by Thorpe on the eve of his departure from Leeds. The memorable series of lectures delivered by Thorpe and his colleagues, under the auspices of the Gilchrist Trust, was published in 1878 and edited by him with the title "Coal, its History and Uses."

Considerable activity in research marked the nine years (1885—1894) of the Professorship at the Royal College of Science, as shown by the papers published, conjointly with others, during that period. The determination of the atomic weight of silicon, with J. W. Young, and of gold, with A. P. Laurie, gave the values 28·3 for the former and 196·7 for the latter of these elements. The investigation with Hambly of the vapour density of hydrofluoric acid, proved the density gradually to diminish between the temperatures of 26° and 88°, and, whilst establishing the correctness of the formula HF, demonstrated that it exhibits association similar to that shown by acetic acid and nitrogen peroxide. With Hambly, Thorpe also prepared gaseous phosphoryl trifluoride, which is produced by heating cryolite and phosphorus pentoxide, and showed it to have the molecular formula $POF_3$. With J. W. Rodger, the corresponding sulphur compound, $PSF_3$, was prepared by the action of phosphorus pentasulphide on lead fluoride. The investigation, made with A. E. H. Tutton, of the changes involved in the burning of phosphorus in a limited supply of air led to the recognition of phosphorus tetroxide, and the isolation of phosphorous oxide, the true nature of which, as an easily fusible (melting at 22·5°) and readily volatile compound, was established. The authors succeeded in obtaining this substance in crystalline form and showed from the vapour density the molecular weight corresponded to the formula $P_4O_6$. A thorough and complete examination of the physical and chemical properties of phosphorous oxide was made, and with the aid of Sir Lauder Brunton its physiological properties were studied, from which it would appear that this compound is the responsible agent in the production of match-makers' disease.

Amongst other publications of this period to be mentioned are: "The Decomposition of Carbon Disulphide by Shock" (a lecture experiment); a lecture experiment to illustrate the phenomena of coal-dust explosions; diethylphosphorous acid (with North Barker); fluosulphonic acid (with W. Kirman); and with L. M. Jones the thermal expansion of specific volumes of certain paraffins and paraffin derivatives. In 1893, the determination of the thermal expansion of liquids formed the subject of a paper read before the Chemical Society. In 1894, with J. W. Rodger, he published a paper on "The Supposed Relation between the Solubility of a Gas and the Viscosity of its Solvent," followed some years later by an account of a research on the viscosity of miscible liquids.

In March, 1894, Thorpe forsook the academic sphere to take up the post of Government Chemist, returning fifteen years later when for three years he took over the duties of Professor of General Chemistry in the Imperial College of Science and Technology. It was after his return to South Kensington that he, with A. T. Francis, made a determination of the atomic weight of strontium.

The writer is indebted to Mr. E. Grant Hooper for the following account of the Government laboratories and of Thorpe's administration and other activities whilst Director.

"This post, to which Thorpe was appointed in 1894, was instituted with the stated object of combining the chemical departments of the Inland Revenue and the Customs, then two separate Services. Both laboratories were originally founded for purely Revenue purposes, but whilst the Customs Laboratory staff continued to be occupied solely with such work, the Inland Revenue Laboratory had been invested with special functions such as Referees under the Adulteration of Food and Drugs Acts and, in addition to Revenue work, had for many years acted as the chemists and chemical advisers of nearly all the other Government Departments. Very large numbers of samples of the widest diversity had been annually examined for the Post Office, the India Office, the Admiralty, the Office of Works, and other civil establishments, and the 'Somerset House Laboratory,' as well as advising in other capacities, had settled the specifications and examined the stores purchased for official use with the exception of explosives, which were dealt with at Woolwich. The 'Inland Revenue Laboratory,' as its official title was, had thus a very wide experience and its staff in 1894 consisted of a chief and deputy, two superintending analysts, five analysts (1st class), seven analysts (2nd class), and forty-five assistants.

"The Treasury decided that the Inland Revenue and Customs Laboratories should be united under the headship of the 'Government Chemist,' who should be paid from the Treasury Vote, although the staff in each case remained members of their original Departments. This continued for several years, but in 1911 a separate establishment, known as the Government Chemists' Department, was created, to which the staff was transferred except for a certain number of young men belonging to the now united Departments of 'Customs and Excise' and who were and are constantly employed on the more simple revenue determinations. The chemical staff at Somerset House had long outgrown its accommodation, and the development of fiscal business, demanding increased room for clerical work, necessitated the removal of the laboratory. The Treasury therefore determined to provide space elsewhere, and almost immediately after his appointment Thorpe and his staff were called upon to design a new laboratory which it was ultimately decided to build just outside Clement's Inn and closely adjacent to the Law Courts and the newer Bankruptcy Buildings. The new Laboratory, a commodious building admirably adapted for the very extensive chemical work, was brought into use in October, 1897. To this building the Inland Revenue staff was transferred, whilst the laboratory at the Custom House was continued for the examination of the more simple and routine Customs or import samples. It is probably little realised how large a proportion of the huge revenue derived from alcohol (now approximately £153,000,000) and from tobacco (now, say, £53,000,000) is really controlled by scientific work. The charging is, of course, done locally by Customs and Excise officers, but the maintenance of the regulations against the use of forbidden materials and adulteration and the checking of exact strengths or proportions wholly depend upon laboratory examination, whilst the assessment of 'drawback,' *i.e.*, the duty returned on exportation or the allowances for waste material destroyed or denatured, is similarly a matter of purely chemical and microscopical determination. Fresh developments occur from time to time and a new method of determining the amount of dutiable ethyl alcohol in fusel oil led to Thorpe's first communication to the Chemical Society on official subjects, a paper entitled 'The So-called Hydrates of *iso*Propyl Alcohol' (J., 1897, **71**, 920), whilst reference may be made to the following papers connected with the everyday work of the laboratory, *viz.*, 'Occurrence of Paraffin in the Leaf of Tobacco' (J., 1901, **79**, 982); 'Carbon Monoxide as a Product of Combustion by the Bunsen Burner' (J., 1903, **83**, 874); 'Estimation of Ethyl Alcohol in Essences and Medicinal Preparations' (J., 1903, **83**, 314); and 'Estimation of Methyl Alcohol in the Presence of Ethyl Alcohol' (J., 1904, **85**, 1).

"Much other work either affecting the public or yielding results capable of other than merely official use was accomplished. For many years there had been a demand for duty-free alcohol which should be less objectionable and if possible cheaper than the duty-free alcohol known as methylated spirit. A committee was appointed, of which Thorpe was a member, which brought into existence what was known as 'industrial duty-free alcohol' and further provided for the special denaturing of spirit in cases where the presence of methyl alcohol or of the impurities in the crude wood spirit used for methylation was objectionable. Industrial alcohol had only half the quantity of crude wood spirit used in ordinary methylated spirit and was free from petroleum spirit, and thus was both cheaper and purer, whilst the wider use of specially denatured alcohol afforded substantial relief to many industries and to the fine chemical trade. Improved alcohol tables were also produced. The official strength of alcohols was 'that indicated by Sikes' hydrometer,' and there was no legal authority to ascertain strength in any other manner. By 7 Edward VII, c. 13, s. 4, authority was given to the Commissioners of Customs and Excise to issue regulations for ascertaining the strength of spirits in terms of the 'proof spirit' defined by 56 George III, c. 140. Tables were prepared showing the specific gravity in air at 60°/60° F. of all strengths of alcohol and the equivalent percentage of absolute alcohol by weight and by volume at 60° F. These tables, printed by the Stationery Office and available to the public, were only published after Thorpe's retirement from the Government Laboratory. Other work of a similar character was connected with sugar. Tables of the specific gravity of solutions of cane-sugar had been published by Bell, Thorpe's predecessor as chief of the Inland Revenue Laboratory, in Part I of his book 'Analysis and Adulteration of Foods,' but on the imposition of the sugar duty tables of the specific gravity of solutions of glucose were necessary to permit of the ready charging of the duty on commercial glucose—such were therefore prepared and brought into use.

"The statutory position of the Inland Revenue chemists as referees in the case of disputed cases under the Food and Drugs Adulteration Acts has been mentioned. For many years difficulties and disputes had arisen in connexion with milk consequent upon the variation in total solids and proportion of butter fat natural to the commodity as drawn from different breeds of cow and under diverse conditions. It had always been evident that to fix a standard, although it might avoid disputes, was not all gain. On the one hand, a workable standard must be lower than the best quality milk, and it was likely that good milk would be systematically reduced to the level of a standard which might be fixed, whilst, further, the existence of a standard was all in favour of the larger organisations and against the smaller men engaged in the trade, who would probably be without chemists or other skilled assistance. In August, 1901, the Board of Agriculture laid down standards for milk solids below which milk was to be deemed adulterated unless the contrary were proved. As Chief Agriculture Analyst under the Board of Agriculture, Thorpe as chief of the Government Laboratory occupied a similar position as referee in disputed cases arising under the Fertilisers and Feeding Stuffs Acts. Just as in the case of milk under the Adulteration of Food and Drugs Acts, standards were laid down for various products and methods of analysis prescribed as the result of collaboration with a committee of representative official analysts.

"Other work connected with the Board of Agriculture may be indicated by the following Government Laboratory publications: 'Effect of feeding Cotton and Sesame Cake on Butter' (A., 1900, i, 237); 'The Fat of the Egg of the Common Fowl' (A., 1902, i, 295); 'Taxine,' the Poisonous Matter of Yew; 'Interdependence of the Physical and Chemical Criteria in the Analysis of Butter Fat' (J., 1904, **85**, 248); 'A Simple Thermostat for Use in Connexion with the Refractometric Examination of Oils and Fats' (J., 1904, **85**, 257); 'Analyses of Samples of Milk referred to the Government Laboratory in Connexion with the Sale of Food and Drugs Acts' (J., 1905, **87**, 206).

"Two subjects of general interest to the public and on which much work was done in the Government Laboratory were connected with lead in pottery glazes and arsenic in food substances and drugs. The Factory Department of the Home Office were, of course, concerned with cases of lead poisoning in industry and especially in connexion with the pottery trade. Regulations as to employment, medical examination of workers, etc., had long been in existence, but a systematic examination of pottery glazes showed considerable variation in the proportions of lead used and in the degree of solubility of the lead, the latter largely depending upon whether the lead was used as a readily soluble compound such as white lead or whether a fritt was first prepared and the glaze was compounded with the use of such a ground lead silicate. At first the trade as a whole considered the use of lead imperative, and even when it was shown that it was possible to use a lead silicate of a comparatively insoluble character difficulties were alleged, notwithstanding the fact that it was shown that, in addition to endangering the health of the pottery workers, there was pottery on the market which was a danger to the public users because acid fruits, mint-sauce, etc., extracted quite notable proportions of lead from the glaze. Ultimately the use of leadless glazes was proved to be quite practicable, and where lead was still employed the use of comparatively insoluble lead compounds was stimulated by the Home Office granting a relaxation of the conditions of employment in the pottery industry where glazes with a minimum lead-solubility were exclusively employed. Papers on this subject are as follows: 'Lead Silicates in Relation to Pottery Manufacture' (J., 1901, **79**, 791; 1910, **97**, 2282), and a lecture at the Royal Institution.

"In 1901, the world was startled by several cases of arsenical poisoning in Manchester and its neighbourhood which were proved to be due to the consumption of contaminated beer. It was ultimately proved that these cases were caused by the use of an impure, *i.e.*, an arsenical, sulphuric acid for the conversion of starchy material into glucose, which in turn had been employed as an adjunct to malt in the brewing of beer. Extensive investigation showed that arsenic in small but appreciable proportions was widely present in beer; malt itself was found to be contaminated in many instances, such contamination arising from the presence of small quantities of arsenic in the coal and coke used for drying the malt on the malt-kilns. The Commissioners of Customs and Excise, having control over the materials used for brewing, were naturally involved and at once issued orders against the use of any material containing arsenic and against the dispatch of beer into consumption if it contained that substance. The Government Laboratory became flooded with samples from all over the United Kingdom, and a Royal Commission was appointed to investigate the subject. Lord Kelvin was Chairman and Thorpe was a member of the Commission. For the rapid determination of the presence of poisonous proportions of arsenic in beer the Reinsch test had been first used. Thorpe demanded of his staff a gravimetric method, although it was pointed out that the Marsh test afforded a ready means of determination and that the quantities of arsenic so far reported were so small that their separation by a gravimetric method from a liquid like beer, containing relatively large proportions of organic matter, was likely to be difficult. Such a process was, however, worked out and evidence was given before the Royal Commission showing the actual separation of fractions of a milligram of arsenic from quantities such as a pint of beer, and the results of the examination of samples from various parts of the country were furnished. Meantime Local Government Chemists had been mainly using the Marsh test, although not without some trouble consequent on the difficulty at that time of obtaining for the hydrogen-production zinc which was itself sufficiently free both from arsenic, on the one hand, and, on the other, from impurities interfering with the regular evolution of the arseniuretted hydrogen where arsenic was present in the substance under examination. In view of these difficulties and largely under the influence of Lord Kelvin, an electrolytic Marsh test apparatus was devised at the Government Laboratory and put into use. The discovery of arsenic in beer led to an investigation of other materials, not merely brewing substances, malt and sugars, coal and coke used for drying malt, but other substances employed for various purposes, and especially drugs. The result was the revelation of the widespread distribution of arsenic in small proportion and the general recognition of the necessity of laying down standards of purity so that, if absolute freedom from arsenic were not attainable at a non-prohibitive cost, yet both the public and the manufacturers and vendors could be protected by stated maxima. In addition to the evidence published by the Royal Commission, reference may be made to the following papers on this subject: 'Estimation of Arsenic in Fuel' and 'Electrolytic Estimation of Minute Quantities of Arsenic, more especially in Brewing Materials' (J., 1903, **83**, 969, 974); 'Note on the Application of the Electrical Method to the Estimation of Arsenic in Wall-papers, Fabrics, etc." (J., 1906, **89**, 408).

"Another subject affecting public health and especially the health of workpeople employed in the lucifer match industry was that concerned with the presence of white phosphorus in matches. When the use of this substance was forbidden, the detection of small quantities of white phosphorus in the presence of red phosphorus or of other phosphorus compounds became a matter of importance. Hence the paper, 'Note on the Detection of White Phosphorus in the Igniting Composition of Lucifer Matches' (J., 1909, **95**, 440).

"In 1907, the Austrian Government having lent to the British Royal Society certain pitchblende residues, Thorpe undertook the purification of the radium chloride and the re-determination of the atomic weight of radium. A very large number of fractional recrystallisations of radium chloride were made in the Government Laboratory and the atomic weight 226·7 was deduced in close agreement with Madame Curie's number, 226·2 (*Proc. Roy. Soc.*, 1908, **80**, *A*, 298)."

Thorpe took part in four eclipse expeditions, *viz.*, that of December 22nd, 1870, in Sicily; of July, 1878, at La Junta, Colorado; of August, 28—29th, 1886, at Hog Island, Grenada, West Indies, and of August 16th, 1893, at Fundium, French Senegal. On the last two occasions observations were made on the photometric intensity of light, which formed the subject-matter of two papers published in conjunction with Capt. Abney (*Phil. Trans.*, 1889, **180**, *A*, 368; 1896, **187**, *A*, 423). After the eclipse expedition in 1878 he and Sir Arthur Schuster made a series of magnetic observations in America along the Fortieth Parallel, which were communicated to the Royal Society in a paper entitled, "A Magnetic Survey of the Fortieth Parallel in North America between the Atlantic Ocean and the Great Salt Lake, Utah" (*Proc. Roy. Soc.*, 1879, **29**, 1; 1880, **30**, 132). This was followed in 1880 by a "Note on the Determination of the Magnetic Inclination in the Azores" (*ibid.*, 1881, **31**, 237).

The results of an extensive magnetic survey of the British Isles made in collaboration with his colleague, Sir Arthur Rücker, during the years 1884—1888 formed the subject of the Bakerian Lecture delivered by Thorpe in 1889 (*Phil. Trans.*, 1890, **181**, *A*, 55); and an extension of this work, containing the records of observations at 205 stations throughout the British Isles, constitutes the volume 1896, **188**, *A* of the *Philosophical Transactions*.

Thorpe was elected to the Royal Society in 1876, served on the Council during the years 1890—1891, 1893—1895, and 1899—1903, acted as Foreign Secretary during 1899—1903, and represented the Society on the occasion of the 200th celebration of the foundation of the Royal Academy of Sciences of Berlin. He delivered the Bakerian Lecture on two occasions, in 1889 and 1904, the results of his determination of the atomic weight of radium being the subject of the second lecture. In 1889 he was awarded a Royal Medal. The President of the Royal Society (Sir Gabriel Stokes), in making this award, spoke as follows: "Professor Thomas Edward Thorpe's experimental work has secured for him a place in the first rank of living experimentalists. His researches, which are not confined to one department of chemical science, are all distinguished both by accuracy and originality of treatment. As examples of the high character of his investigations, those of the determinations of the atomic weights of titanium and gold may be specially cited as permanently setting the value of two most important chemical constants; whilst his researches on fluorine compounds, including the discovery of thiophosphorylfluoride, a body capable of existing undecomposed in the state of gas, and his latest work on the vapour density of hydrofluoric acid, do not fall short of the highest examples of classical chemical investigation."

It was at the Edinburgh Meeting of the British Association in 1871 that Thorpe acted as Secretary of Section B (Chemistry) and fifty years later he was President of the Association at its meeting in the same city. At the Leeds Meeting in 1890, he presided over the Chemistry Section. The Presidential Address at the Edinburgh Meeting which, owing to illness, he was unable to deliver in person, was devoted to a plea for an international ban on chemical warfare. He served on several Royal Commissions and numerous Departmental Committees, was an active member of the International Committee of Atomic Weights, contributing experimental data for the determination of the atomic weights of no fewer than six elements. In 1895 he was elected President of the Society of Chemical Industry.

The record of Thorpe's scientific investigations and achievements shows how abundantly he gave of himself without stint or reserve to the advancement of knowledge, and this with a success indicated in the many recognitions and honours received by him from universities and learned societies both at home and abroad. In 1900 he was made a C.B., and on retiring from the Directorship of the Government Laboratory was knighted. In 1912 he resigned the Chair of General Chemistry at the Imperial College of Science and Technology and went to reside at Salcombe in South Devon, where he had built a house, and there devoted himself to literary work, yachting, and gardening. Sailing remained a lasting source of pleasure to him, and it is characteristic of the man that he should use his pleasure cruises as opportunities for research, as in the case of the magnetic surveys, already mentioned. Further, his yachting experiences were made to provide the material for those literary excursions: "A Yachtsman's Guide to the Dutch Waterways" (Standford, 1905), and "The Seine from Havre to Paris" (Macmillan, 1913). The revision and enlargement of the "Dictionary of Applied Chemistry" occupied him to within a few days of the illness which, as already stated, terminated fatally on February 23rd, 1925.

As to Thorpe's influence and personality, no better testimony is needed than that expressed by Dr. Tutton in the obituary notice published in the *Proceedings of the Royal Society* in December, 1925: "An able and incisive speaker, compelling attention (in spite of his stature) both by his resonant voice and his always interesting matter, a brilliant lecturer and experimenter, a faithful teacher who never failed to make himself clearly understood, and an original investigator of keen penetration, infinite reserve, consummate manipulative skill, scrupulous accuracy and its ever accompanying quality of neatness, Sir Edward Thorpe not only inspired those who had the good fortune to study under him, but impressed the honourable mark of thoroughness and trustworthiness on the department of British Science which he so well represented. The spirit of research ever emanated from him and vivified all his teaching, and it may be hoped, and indeed believed, that its leaven has quickened the spirit of a band of devoted students, striving to emulate his fine example and to work for the honour of British Science and the acquirement of true knowledge for its own sake, throughout the whole Empire."

In conclusion the writer wishes gratefully to acknowledge the kindness of Lady Thorpe and her niece (Miss Watts) in placing at his disposal documents relating to the life and work of Sir Edward Thorpe.

P. P. B.