OBITUARY NOTICES.

FREDERICK BRADSHAW.

1877—1935.

FREDERICK BRADSHAW, M.A., D.Sc., Librarian of Armstrong College, Newcastle upon Tyne, died on December 29th, 1935, at the age of 58. He was a native of Leeds and received his education at Leeds Grammar School and Brasenose College, Oxford. After graduating, he studied in Germany and London, proceeding to the degree of D.Sc. at the London School of Economics.

Bradshaw was appointed Lecturer in the Department of Modern History at Armstrong College in 1904 and held this position until his appointment as Librarian in 1921.

In the field of scholarship his most important contributions were " A History of Modern England," " Self Government in Canada," and " A Social History of England." He took an active part in the work of the Historical Association and the Newcastle Society of Antiquaries, contributing several papers to the latter which have appeared in its *Proceedings* and " Archæologia Æliana."

Bradshaw is greatly missed, for all with whom he came in contact could not fail to admire his scholarship, respect his advice, and esteem his kindly nature. L. A. SAYCE.

JACK WARD DRAKE.

1914—1937.

THE death of Jack Ward Drake at the early age of twenty-two has deprived the Chemical Society of one of its youngest Fellows. He was born on July 25th, 1914, and received his general education at Heckmondwike School, Yorkshire. There he had a brilliant scholastic career and established for himself a reputation for wise and sympathetic leadership. His interest in science was early apparent and the school scientific society enjoyed a very successful period under his enthusiastic guidance.

Drake entered the University of Leeds in October, 1933, to study for an Honours degree in Chemistry. A keen student and one who regarded his work with intense seriousness he tended, in consequence, to become rather quiet and reserved. His interests, however, were far from narrow, for, in addition to his degree courses, he studied music and was an efficient member of the Officers' Training Corps. He graduated with Honours in 1936 and was elected a Fellow of the Chemical Society in the same year.

Unknown to his friends, Drake must have fought a hard battle against ill-health during the latter portion of his University career. Wishing to return to undertake post-graduate research work, he had accepted a vacation post at the Fruit and Vegetable Preservation Research Station at Campden, Gloucestershire, but a severe hemorrhage revealed advanced tuberculosis and enforced an early return to his home. In Middleton Sanatorium at Ilkley he at first made good progress towards recovery, but an attack of pleurisy intervened and he died on Sunday, April 11th, 1937. A young man of sterling character, showing considerable scientific promise, his death at the threshold of his career is a tragedy deeply regretted by all his friends. J. W. BAKER.

GEORGE INGLIS HUDSON.

1863—1936.

GEORGE INGLIS HUDSON was the son of Thomas Inglis Hudson, timber and shipping merchant, and was born at Hobart, Tasmania, on September 5th, 1863. He was educated at the Hutchens Private School, Hobart, and in 1880 came to reside in Sydney, New South Wales, where he qualified in pharmacy. He married Miss Mary Louise McCloy, and in 1889 transferred his activities to Ipswich, Queensland, where he established an extensive practice in pharmacy and dentistry. It was here that he devised and put into operation his formula for "Hudson's Eumenthol Jubes," which are widely known throughout Australia and abroad. In 1907 he returned with his wife and daughter to Sydney, where he founded and controlled a business as manufacturing chemist under the title of "Hudson's Eumenthol Chemical Co." His residence in Sydney gave him the opportunity to take a refresher course in organic chemistry at the Sydney Technical College under the tuition of the late Henry G. Smith, with whom he later became a close associate, so much so that his name appears with that of Smith in Martindale's "Extra Pharmacopœia" in connection with eucalyptus oil.

Hudson was one of the group of students and teachers who interested themselves in the foundation of the Sydney Technical College Chemical Society in 1913, and became a member of the first Council. At one of the Society's meetings in 1916 he exhibited a specimen of pure cineole, which he was producing on a technical scale at his works by a method he had developed in collaboration with H. G. Smith.

As an earnest of his continued interest in the advancement of organic chemistry he bequeathed a sum of £1000, to be used by the University of Sydney and the Technical College for the purpose of encouraging students in the study of that branch of chemistry.

Hudson was elected a Fellow of the Chemical Society in 1917. He was a member of the Royal Society of New South Wales and of the Sydney section of the Society of Chemical Industry, as well as of the New South Wales Club, the Australian Golf Club, and the Australian Jockey Club.

He died at a private hospital in Darlinghurst, Sydney, on April 15th, 1936, and was interred in the Presbyterian section of the Waverly cemetery, the final token of respect and regard being paid by his colleagues and many of Sydney's representative citizens.

R. W. CHALLINOR.

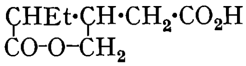
HOOPER ALBERT DICKINSON JOWETT.

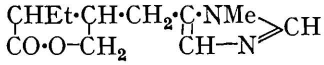
1870—1936.

Dr. H. A. D. JOWETT died in the County Hospital, Dartford, on August 10th, 1936, as the result of a motor accident. Though a Dorsetshire man by birth, being born at Dorchester on April 25th, 1870, he was educated at the Royal Lancaster Grammar School and served an apprenticeship in pharmacy in Lancaster. Thanks to the external degree system of London University, he was able to make some progress towards the London B.Sc. degree during his apprenticeship, at the end of which he was a successful candidate for one of the scholarships awarded annually by the Pharmaceutical Society in memory of Jacob Bell. After the usual course in the Society's College he took his diploma of Pharmaceutical Chemist in 1892 and the B.Sc. (London) degree in 1893, and in the following year was appointed demonstrator in the Society's Research Laboratories, under the direction of Professor (now Sir) Wyndham Dunstan.

Work on aconitine was then in progress, and the first paper in which Jowett was concerned dealt with the three interconvertible forms of aconitine aurichloride. This was followed by his thesis for the D.Sc. (London) on atisine, the non-toxic alkaloid of *Aconitum heterophyllum*. In the same year, 1895, the late Sir Henry Wellcome founded the Wellcome Chemical Research Laboratories under the direction of the late Dr. F. B. Power, and Jowett was appointed on the staff of the new laboratories; he remained there until, in 1906, he moved to Messrs. Burroughs Wellcome & Co.'s works at Dartford to organise a Works Experimental Department. He had by that time acquired a reputation as a research worker and his managing and organising abilities made him an obvious choice for the position of Works Manager to which he was appointed in 1907, and in which he was to remain for the rest of his life.

Jowett's best-known work is that on the Jaborandi alkaloids begun in 1900, when there was still considerable confusion as to the actual alkaloidal constituents of the drug and practically nothing was known regarding their constitution. His first care was to characterise and describe fully the principal alkaloids, pilocarpine and *iso*pilocarpine, and to confirm the existence of pilocarpidine, which is only found in one variety of the drug. In the ensuing work on the constitution of the two principal alkaloids, it was shown that the greater part of the molecule consisted of the residue of a new open-chain lactone acid, homopilopic acid (I).


(I.)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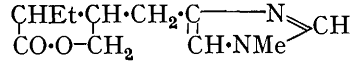
(III.)

In the meantime work on these alkaloids had also been started in Germany, and Pinner and Schwarz in 1902 were the first to suggest that the rest of the molecule consisted of a methylglyoxaline nucleus and to propose that *iso*pilocarpine might be represented by formula (II). This kind of structure is unique among alkaloids and has not been found outside the genus *Pilocarpus*, which belongs to a botanical family, *Rutaceæ*, remarkable for the diversity of alkaloidal types found in its genera. Jowett was able to confirm this formulation as the result of a study of the glyoxalines formed by the distillation of *iso*pilocarpine with soda lime and careful determination of the characteristics of a series of synthetic glyoxalines, and in the following year accepted Pinner and Schwarz's formula, with the qualification that the methyl group in the glyoxaline nucleus might equally well be in the alternative position as in (III). This point was settled in favour of formula (II) by Pyman in 1922, who showed that the dimethylglyoxaline formed when *iso*pilocarpine is distilled with soda lime is the 1 : 5-derivative. Jowett also observed the interconvertibility of pilocarpine and *iso*pilocarpine, a useful addition to the previously accumulated evidence that the two alkaloids are stereoisomerides. All these results have been confirmed by the synthesis, by other workers, first of pilopic and homopilopic acids and quite recently of pilocarpine and *iso*pilocarpine.

Jowett also did useful work, partly in collaboration with Pyman, in tracing the influence of changes in chemical constitution on physiological action, particularly in regard to the mydriatic action of the tropeines, and he was one of the pioneers in the chemical investigation of hormones, doing work on the constitution of adrenaline in 1904 and being associated with Barger in the synthesis of substances allied to adrenaline. Apart from these main problems he made notable contributions to the chemistry of other natural products such as the *Salix* glucosides, barbaloin, chrysarobin and cascara bark and with Pyman he investigated the interesting *iso*quinoline alkaloids of *Zanthoxylum brachyacanthum*.

During the war years Jowett was fully absorbed in strenuous efforts to meet the demand for synthetic drugs previously imported from Germany; among the successful achievements under his management was the manufacture of arsphenamine, neoarsphenamine and other complex synthetic drugs not previously made in this country. These developments were continued after the war, and the rapidity with which the manufacture of modern remedies such as insulin, ephedrine and ergometrine was undertaken is a tribute not only to Jowett's scientific acumen, but to his skill as an administrator and to his vigorous and inspiring personality.

Jowett held a commission as lieutenant in the 4th Volunteer Battalion of the Royal West Kent Regiment during the War and in recent years played a considerable part in local affairs; he was a member of the Dartford Borough Council and as Chairman of the Public Health Committee rendered great assistance in the solution of the complex problems that arise in modern municipal government. In spite of his preoccupation with administrative work and public duties, he found time to take an interest in scientific progress and he thoroughly enjoyed discussions with his friends on recent developments. He was a Freemason, an enthusiastic Wagnerian, a keen golfer, and one of the earliest devotees of motoring and to the end of his life he maintained his interest in the technical equipment of cars and his pleasure in driving. Jowett was above all a kindly and very human person; his all-round interest in human achievement did not prevent his having a few pet aversions, but even the proponents of views he disliked could always count on a fair and courteous hearing and a willingness to compromise if such were possible without sacrifice of principle.

T. A. HENRY.

SIDNEY SCRIVENER NAPPER.*

THE death is announced of Sidney Scrivener Napper at the age of 57.

Educated at Owens School, Islington, he went to South Kensington in 1896 and took his diploma of Associateship of the City and Guilds Institute in 1900. While there he came under the influence of Prof. H. E. Armstrong, whose private assistant he was for a time, and of W. J. (now Sir William) Pope, to whom he was indebted for his enthusiasm for crystallography and microscopy.

After a year or two in a gas-mantle industry, he joined the chemical staff of the Royal Gunpowder Factory, Waltham Abbey, in 1901, and brought to bear with success the influences mentioned above on the investigations then in hand on cordite and its ingredients, as well as on the general work of the central laboratory. Believing that he had need of practical contact with an industrial process, he left the R.G.P.F. in 1904 and took a post with the Otto-Hilgenstock Coke Oven Co., where the work was at least strenuous.

As he had been associated with the writer in experimental work on the mode of decomposition of nitrocellulose, he returned to the R.G.P.F. for a period during which that phase of the work was completed. It will be found in the *Journal* of the Chemical Society : " The estimation of small quantities of nitrogen peroxide " (spectroscopically), p. 761, 1907, and " The evolution of nitrogen peroxide in the decomposition of gun-cotton," p. 764, 1907.

Experience with cellulose at the R.G.P.F. brought him to the notice of the late C. F. Cross, who obtained for him an appointment with Messrs. Courtauld at Coventry, in 1905. This firm was then starting the manufacture of viscose silk and the technical difficulties in production were so great as seriously to jeopardize its chances of success. It is understood that the situation was to a great extent saved by Napper who, by a suitable choice of a liquid for treating the extruded threads, gave them the necessary strength to permit of their being handled, and by attention to the conditions of storage of the material at an earlier stage overcame the difficulty of want of uniformity in the thread when it came to be dyed. The process of extrusion of a colloidal material was of course one with which he had been familiar in the cordite factory at Waltham Abbey.

Napper became chief chemist to Courtauld's in 1917, and for a few years was engaged with the Courtauld Development Department, having a laboratory in London and conducting experimental work resulting in several patents. In 1923 he retired from this and engaged in consulting work for the most part connected with developments of viscose.

After he left Coventry he lived at Bournemouth, and his friends who visited that town during the meeting of the British Association in 1919 will remember with pleasure his house and landscape gardening. For he was an enthusiastic gardener, specializing in herbaceous plants. The writer well remembers how the scent of a few heads of one of his rhododendrons perfumed the office of the Government Laboratory. The surrounding district was a fascination to him on account of the prehistoric remains throughout Dorset, and of these he had acquired much knowledge. Later, he came nearer London and lived at Woking.

Possessed of a keen and logical mind, Napper tenaciously followed his ends with enthusiasm and knowledge, and this can be said both of his research work and also of his contributions to the technology of artificial silk. He was of a reserved disposition, and was not always understood, but his intimate friends knew and appreciated him. He had artistic abilities which found their expression in the furnishing of his house and the laying out of gardens, and also in photography, in which he had expert knowledge.

He leaves a widow and two children.

R. ROBERTSON.

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DAVID SOMMERVILLE.

1864—1937.

DAVID SOMMERVILLE, who died after a short illness on January 30th last, was born in 1864, the eldest son of the late John Sommerville of Benburg, Co. Tyrone. Though settled in Ireland, the family was Scottish, descendants of a son of Sir Gautier de Sommerville, one of William the Conqueror's generals, who settled in Scotland. He was educated at a private school at Dungannon, showing exceptional ability and gaining many prizes, notably in mathematics, which always had an attraction for him. He afterwards entered Queen's College, Belfast, and obtained the B.A. degree, Royal University of Ireland, in 1895. He took the medical course there and at Middlesex Hospital, London, and graduated M.B., B.Ch., R.U.I., in 1895, and M.D. in 1897. Later, he obtained the Diploma in Public Health, University of Cambridge, and the Membership of the Royal College of Physicians, London.

Sommerville's first appointment was in 1898 as Lecturer on Physiology at Cook's School of Anatomy, Brunswick Square, London, and he was Demonstrator of Physiology at St. Thomas's Hospital, 1900—1902. In 1903 he was elected Demonstrator in the State Medicine Department, King's College, and was promoted to Lecturer in Public Health in 1905 and to Assistant Professor of Hygiene in 1913, in King's College, University of London; this post he held until the transfer of the Department to the London School of Hygiene and Tropical Medicine in 1925.

At King's College, Sommerville was in charge of the course in chemistry and the teaching required for the diploma and degrees in public health. He was an excellent teacher, and took much trouble in the instruction of his students and in the conduct of the classes. He was examiner for the Diploma and Degrees in Public Health at Edinburgh University and elsewhere on two or three occasions.

Sommerville's inclinations and bent were, however, mainly chemical, and he was much interested in the chemistry and bacteriology of disinfection, water and sewage, but his activities, particularly during the War, ranged over a variety of subjects. These included dermatology and clinical medicine—gastric disorders, involving, as they do problems of a chemical nature, were of special interest to him—and he held for short periods posts as pathologist to the Hampstead Military and Royal Herbert Hospitals, and as Medical Officer of Health at Harrow and at Coulsdon. If he had concentrated more on one or two subjects, he would doubtless have gone much farther than he did as an original investigator.

Of his published work, several papers were contributed, separately or in collaboration with the late J. T. Ainslie Walker, on the Rideal–Walker method for the standardisation of disinfectants, including suggestions for the introduction of organic matter into the test. In 1906, Professor Sommerville gained a "Society's Premium" for a paper entitled "Some Observations on the Chemistry and Bacteriology of Potable Waters," and in 1909 he was awarded the "President's Gold Medal" for a paper on "The Chemistry and Bacteriology of Sewage Purification," both at the Society of Engineers. He gave two courses of Cantor Lectures at the Royal Society of Arts, one in 1913 on "Antiseptics and Disinfection," the other in 1915 on "Foodstuffs"; the last-named contains an admirable summary of what was known at the time concerning the amino-acids of protein and of the chemical changes occurring in the digestion of proteins. A paper on the hydrolysis of vegetable oils by castor bean was contributed to the *Biochemical Journal* in 1911. He sat on numerous committees, and was a member of the Executive Committee of the British Science Guild, and for a time Honorary Secretary of its Health Committee.

Sommerville's Irish upbringing doubtless helped to form his character, with its humour and somewhat casual bearing, but he was a good friend to all who knew him intimately. He enjoyed his golf and maintained his many interests and friendships to the last, for the years dealt kindly with him, and he will be missed by a large circle, including his widow, a sister-in-law of the late Professor Meldola. R. TANNER HEWLETT.

MICHAEL EDMUND STEPHENS.

Michael Edmund Stephens was the son of the late Mr. Henry C. Stephens, who for many years represented Hornsey as a Member of Parliament. His grandfather was Henry Stephens, the founder of the business of Henry C. Stephens, Ltd., and the first inventor of blue-black writing ink. Michael Stephens was educated at Rugby, and on leaving school went into the business with his father. He possessed great business aptitude and in 1918 was admitted into partnership. In 1925, the business was formed into a public company with a capital of £850,000. Stephens retired from the Board of Directors in 1926, and his death took place on February 12th, 1936.

He was elected a Fellow of the Chemical Society on December 2nd, 1897.

SYDNEY YOUNG.

1857—1937.

Sydney Young was born at Farnworth near Widnes on December 29th, 1857. His father, Edward Young, was a Liverpool merchant and Justice of the Peace for the county of Lancashire. Young was educated privately and received his training in chemistry under Sir Henry Roscoe and Prof. Carl Schorlemmer at Owens College, Manchester, and Professor Fittig in Strasburg. He matriculated in the University of London in 1877, graduated in 1880, and was awarded the degree of D.Sc. three years later.

In 1880 the Chemical Society at Owens College was founded by the students and Young and Arthur Smithells followed Cross and Bevan as joint secretaries. It was to this society that, at Roscoe's suggestion, Young demonstrated Carnelley's discovery that ice exposed to very low pressures cannot be liquefied even by the application of great heat, and he then offered an explanation the experimental verification of which was published with Ramsay in the *Philosophical Transactions* of the Royal Society early in 1884. It seems probable that this experiment, carried out in his student days, first attracted Young's attention to a subject on which he commenced to work after his appointment in 1882 as Lecturer and Demonstrator in Chemistry under Ramsay at University College, Bristol.

There is a note in *Chemical News* (1883, 104) on a simple apparatus to show Carnelley's experiment and a further modification was devised in conjunction with Ramsay which enabled the temperature of the ice to be determined and the pressure in the apparatus to be calculated.

The joint investigation was continued, and the apparatus improved and rendered suitable for the determination of boiling points of liquids as well as the volatilising points of solids, both temperature and pressure being read directly. By means of this apparatus it was definitely proved, first, that the graph representing the vapour pressure of ice at different temperatures represents also its volatilising point under different pressures, and, secondly—as predicted by Professor James Thomson and independently by Kirchhoff—that the vapour pressure of ice, at any temperature below the triple point, is lower than that of water. This investigation was extended to other volatile solids, and in addition to such substances as ammonium chloride, chloral hydrate, etc., which undergo dissociation on vaporisation. The results were described in a series of joint papers with Ramsay on " Evaporation and Dissociation," published in the *Transactions* of the Royal Society and in those of the Chemical Society between 1884 and 1886.

For some time previously Ramsay had been engaged in investigating the vapour pressure, specific volume and critical constants of some liquids, employing a pressure apparatus similar in principle but differing in detail from that used by Andrews in his classical work on carbon dioxide. At Ramsay's invitation, Young now joined him in this research. A description of the apparatus will be found on p. 122 of Young's " Stoichiometry," 2nd Ed., 1918 (Longmans and Co.), and a model is now in the South Kensington Museum.

The thermal properties were determined of ethyl ether, methyl, ethyl, and propyl alcohols, acetic acid, and a mixture of ether and ethyl alcohol. In this work constant temperatures were obtained by means of the vapours of liquids boiling under known pressures. The results showed that at constant volume the relation between the temperature and vapour pressure of a liquid is represented by the formula $p = bT - a$, where b and a are constants depending on the volume. It was found, however, that the relations between pressure and volume are not accurately represented by van der Waals' equation of state, although the above expression may be deduced from that equation. Later Young found that in most cases the relationship just mentioned is not strictly true except at large and possibly at very small volumes.

During these investigations Young had noticed that the value of $T \cdot dp/dt$ at the same pressure was the same for such closely related substances as chloro- and bromo-benzene; in consequence, he made a systematic study of the vapour pressures of numerous substances previously determined by Regnault, by Ramsay and by himself. He and Ramsay found that for two substances which are not closely related, the values of $T \cdot dp/dt$ are generally only approximately equal, and that the differences are evidently real and not due to experimental error, since the ratio between the two values for the expression remained the same at all pressures.

In the case of dissociating substances the values were usually widely different. A preliminary account of these results was communicated to the British Association in 1885, and the whole subject discussed, and other relations described, in a series of joint papers with Ramsay under the general title of "Some Thermodynamical Relations," in the *Philosophical Magazine* in 1885 and 1886. Of these, that concerned with the boiling points of different liquids at a series of equal pressures is of very general utility.

In these investigations, calling R the ratio of the absolute temperature of two liquids at any one vapour pressure, and R' the ratio at another, the relationship found was expressed by the equation $R' = R + c(t' - t)$, where c is a constant, and t and t' the temperatures of one substance corresponding to the two pressures. For closely related substances, as a rule $c = 0$, for others it is very small, but the relationship does not hold for materials whose molecules undergo either dissociation or association. At a later date, Young expressed his surprise on finding that the law did not hold accurately for the homologous series of the normal paraffin hydrocarbons.

In 1887 Ramsay succeeded Williamson in the Chair of Chemistry at University College, London, Young was appointed to the Chair at Bristol, and the partnership, which had lasted five years and during which more than thirty joint papers had been published, came to an end.

Young then commenced a systematic investigation of the vapour pressures, specific volumes, and critical constants of a series of pure liquids, for he desired to obtain further light on the relationships previously mentioned, and to test the validity of the generalisations of van der Waals regarding corresponding temperatures, pressures, and volumes. Communications on the generalisations of van der Waals and on the determinations of the critical volume were published in the *Philosophical Magazine* of 1892.

The specific volumes of liquids obtained by direct readings were found to be unsatisfactory at high temperatures, and the method Young employed in nearly all cases consisted in calculating the specific volumes of both liquid and saturated vapour from a series of readings of the volumes of liquid and vapour. For those substances which attack mercury, he devised a new method, determining the specific volumes of both liquid and saturated vapour by using sealed tubes. This method proved to be so satisfactory that it was employed for all the substances he examined.

From 1888 onwards Young investigated a large number of liquids, firstly those closely related, such as benzene and its four monohalogen derivatives, the tetrachlorides of carbon and tin, and ten aliphatic esters. At this period, however, it had become recognised that the physical properties of compounds containing a hydroxyl group, such as water, the alcohols, and acids, are abnormal in many respects. It was known that the molecule of acetic acid was associated in the vapour phase and the conclusion was reached that the molecules of all these substances are associated in the liquid state.

For these reasons, among others, Young then passed to the study of the lower members of the paraffin hydrocarbons, since he considered that they were least likely to behave abnormally. *n*-Pentane, *n*-hexane, *n*-heptane, *n*-octane, and *iso*pentane were carefully investigated, and the last substance found to be exceptionally valuable for the complete study of the compressibility of liquid and unsaturated vapour, as well as the vapour pressure and specific volumes. A series of papers on the thermal properties of these hydrocarbons was published between 1894 and 1899, some in collaboration with G. H. Thomas and others with J. Rose Innes.

The study of these hydrocarbons naturally led Young to consider the possibility of separating a number of substances from American petroleum, but all attempts with the apparatus then available proved fruitless.

The preparation of the various liquids used in his researches had of necessity drawn Young's attention to the problem of distillation, and an excellent summary of the advances he made in this somewhat neglected subject will be found in his article on "Distillation" in Sir Edward Thorpe's "Dictionary of Applied Chemistry." In conjunction with G. L. Thomas in 1897 he devised a dephlegmator on the principle of that which forms part of the Coffey still, and this, in conjunction with a regulated temperature still-head, enabled them to prepare pure specimens of *n*- and *iso*-pentane from the lower-boiling fractions of petroleum. It was also found that American petroleum, like Russian, contains penta- and hexa-methylenes and their methyl derivatives. In fact, Young showed that the composition of American petroleum is similar to that of the Russian and Galician oils, the only difference being the relative proportions of paraffins, polymethylenes, and aromatic hydrocarbons present. The thermal constants of hexamethylene, di*iso*propyl, and di*iso*-butyl were described with Miss Emily C. Fortey in 1899 and 1900. *n*-Hexane, prepared by the fractionation of benzene-free petroleum, cannot be separated from *iso*hexane and methyl-pentamethylene by fractional distillation. In 1898, however, the action of fuming nitric acid on different classes of hydrocarbons had been investigated in collaboration with F. Francis, and as a result it was found that, through the agency of this acid, the two other constituents could be removed, and pure *n*-hexane isolated from petroleum for the first time. The action of chlorosulphonic acid on the paraffins was investigated in 1899. Many years later (1933), Young received a letter from the Petroleum Division of the American Chemical Society expressing their high appreciation of his work on distillation, on the composition of petroleum, and on the determination of the physical properties of numerous hydrocarbons.

In 1905 the question had been raised as to whether the vapour pressure of a pure substance is independent of the relative volume of liquid and vapour. Young discussed this in a paper published in the Royal Dublin Society's *Journal* (1906, **11**, 89). Data from previous communications showed conclusively that when a substance is free from all impurities, including dissolved air, the vapour pressure remains constant irrespective of the relative volumes of liquid and vapour.

Young discussed the "Law of Cailletet and Mathias and the critical density" in a communication to the *Philosophical Magazine* in 1900, and a controversy arose later regarding the condition of matter at the critical point, some contending that the critical temperature was not a true constant and that a substance at the critical state was not really homogeneous. The evidence of Young's prolonged investigations was all in favour of what may be regarded as the orthodox view that the densities of liquid and vapour become identical at the critical point. The critical density is very difficult to determine experimentally, but Cailletet and Mathias arrived at the conclusion that the mean of the densities of any substance, in the state of liquid and saturated vapour, plotted against the temperature, fall on a straight line, $S_t = S_0 + \alpha t$, where S is the density or specific gravity. Young found that this relation was strictly true for *n*-pentane, but that in most cases there was very slight curvature, or $S_t = S_0 + \alpha t + \beta t^2$. The ratio of the actual to the theoretical density at the critical point was found to be much higher than would be required by the van der Waals formula and to range from 3·68 to 3·86 for the normal substances investigated. There was also found to be a definite connection between this ratio and both the constant β in the Cailletet–Mathias modified formula and other physical constants. The experimental data for the densities of saturated vapour are necessarily less accurate at low temperatures than at high, but in 1908 a theoretical method of correction was devised by Young, and the vapour pressures, specific volumes (densities), and critical constants of the thirty pure substances previously investigated were carefully revised, and the complete data published in 1910 in the *Scientific Proceedings* of the Royal Dublin Society.

Kopp concluded in 1842 that a constant difference in chemical composition is accompanied by a constant difference in boiling point, and two years later, took 19° as the true difference for an addition of CH_2 in any homologous series. This erroneous conclusion was due to the fact that most of the substances he examined were characterised by molecular association. Young suggested in his presidential address to the chemical section of the British Association at Cambridge in 1904, that in order to ascertain the normal behaviour of pure substances it is advisable at first to examine only those whose molecules show no sign of association in either the gaseous or the liquid state. As regards the boiling points of the *n*-paraffins at 760 mm., it was known that the rise in temperature for an addition of a CH_2 group was very far from constant. James Walker and later Ramage suggested formulæ based on the number of carbon atoms in the molecule, and Young in his address pointed out that the difference in temperature, Δ, might be regarded as a function of the temperature only, and suggested the formula $\Delta = 144{\cdot}86/T^{0{\cdot}0148\sqrt{T}}$. This formula gives better results than those of Walker and Ramage. Moreover, it was found to be applicable with fair accuracy, not only to the *n*-paraffins, but also to any two consecutive members of any homologous series provided that the molecules of each substance contain at least one CH_2 group united to two carbon atoms, and further, that there is no molecular association.

This relationship, and that between critical temperature and boiling point, was again discussed by Young in 1916 (Royal Dublin Society) and 1928 (*Proceedings* of the Royal Irish Academy). He pointed out that the general formula $\Delta = A/T^{B\sqrt{T}}$ is applicable, as far as data are available, to all the *n*-paraffins from C_3H_8 to $C_{35}H_{72}$, under all pressures from 11 mm. to 20,000 mm. The constants *A* and *B* depend on pressure and methods for calculating their values are given in these papers. Tables are also given of the observed boiling points at a series of pressures of all the *n*-paraffins up to $C_{35}H_{72}$, and the boiling points calculated by three different methods, together with the most probable values derived from those observed and calculated.

This sketch of Young's investigations cannot be concluded without again alluding to the problem of fractional distillation in which he did so much pioneering work. His skill in glass blowing, gained when a student at Strasburg, was of inestimable value to him in this work, since it enabled him to construct various forms of still-heads. The efficiencies of these were compared in 1899 and the economy in material and time effected by using the most efficient was stressed in various papers. An account of this work, published under the title " Fractional Distillation " by Macmillan and Co. in 1903, is now out of print. The more recent edition " Distillation Principles and Processes," 1922, written in collaboration with Col. E. Briggs, T. H. Butler, T. H. Durrans, the Hon. F. R. Henley, James Kewley, and J. Reilly, is greatly enlarged and extended by the addition of chapters on the distillation of petroleum, coal tar, alcohol, etc., each written by experts.

The study of the vapour pressures and boiling points of mixed liquids (Part I appeared in the *Transactions* of the Chemical Society for 1902) led to the discovery of new binary (azeotropic) mixtures of constant boiling point, and it was found that ternary azeotropic mixtures of the lower alcohols, except methanol, with benzene or *n*-hexane and water could also be prepared. This enabled Young to devise a new method for the dehydration of ethyl alcohol by distillation with benzene, which was first adopted by the firm of Messrs. Kahlbaum of Berlin, and later by others.

By far the greater part of Young's work (he published over 100 papers in all) was carried out during the 21 years that he spent in Bristol. There the amount of teaching and administration was small, and he had ample time for experimental work. He was 46 when in 1903 he was invited to succeed Emerson Reynolds in the Chair of Chemistry at Trinity College, Dublin. This appointment involved a large increase in his administrative and teaching duties, his lectures being attended by the numerous students of the flourishing medical school, as well as by those taking courses in engineering and experimental science.

It was inevitable that these increased responsibilities should reduce his output of original work, but his interest in it had not diminished, and from time to time he published papers, some of which are alluded to above, as well as the two works on distillation and stoichiometry.

During the War and immediately after, Young was compelled to undertake an amount of work which would have severely taxed the strength of a much younger man. The medical and engineering schools very largely increased in numbers, and Young was always meticulously careful in the routine work of examinations. But in addition to his greatly augmented duties at Trinity College he was one of the Vice-Presidents of the Chemical Society from 1917 to 1920, a member of the Advisory Council of the Department of Scientific and Industrial Research from 1920 to 1925—in these capacities he made over a hundred journeys to England—and President of the Royal Irish Academy from 1921 to 1926, filling with distinction a position which has been occupied by many famous men and in which " his tact, kindliness and known moderation did much to ease a difficult period of transition."

Professor Bailey writes of Young's lectures at Trinity College after the war :—" When the College halls were once more filled with students, the writer was one among the boisterous crowd who, freed from sterner discipline, flocked into the Department of Chemistry. They found there a Professor who lectured with extreme clarity, who illustrated his lectures by blackboard drawings which were the work of an artist (which indeed he was), and who, above all, set an example of old-world courtesy which made the deepest impression on those who experienced it."

Shortly before his retirement in 1928, after a quarter of a century of service in Dublin, Young was the recipient of an address from over two hundred of his friends, former pupils, and those who were acquainted with his work. The signatures came from all over the world and among those who took a prominent part in this act of recognition were Dr. W. R. G. Atkins and Professor J. Timmermans.

When as a young man Young went to Owens College, the first friend he made was Charles Kimmins, now well known as an authority on psychology and education. Dr. Kimmins remained his best friend all his life, and in 1896 Young married his sister, Grace Martha Kimmins. In 1897 they had twin sons born to them, Sydney Vernon, who passed high into the Royal Academy at Woolwich and gave promise of making for himself a brilliant career in the Royal Engineers, but was killed in action before Ypres in 1915, and Charles Edgar, who came safely through the war and is now headmaster of Lincoln School and headmaster elect of Rossall.

Young was a man who made lasting friendships. He and Mrs. Young found Dublin society very congenial and their house, first in Raglan Road and later in Clyde Road, became an intellectual centre. On his retirement, they returned to the neighbourhood of Clifton, Bristol, where he was able to enjoy his favourite hobby of gardening. In these last placid and happy years he renewed many old friendships that he had never forgotten. Towards the end his thoughts turned more to early days, and it gave him very great pleasure when he was made President of the Old Students Association of Owens College, Manchester, a few months before he died. He passed away in his 79th year, after a very brief illness, on April 9th, 1937, and is survived by his wife and son.

Young was elected to the Royal Society in 1893, received the honorary degree of Sc.D. Dublin in 1905, the D.Sc. of his old college, now the University of Bristol, in 1912, and the M.A. of Dublin in 1921.

My thanks are due to Mr. C. E. Young for the loan of many of his father's notes, and to Professor Kenneth C. Bailey for information about his life in Dublin.

F. FRANCIS.