OBITUARY NOTICES.

SIR MARTIN ONSLOW FORSTER.*

1872—1945.

Martin Onslow Forster was born in South London on November 8th, 1872; he died in Mysore City on May 24th, 1945, in his 73rd year. He was the fourth and youngest child of Martin Forster (d. 1908) and Anne Hope Limby (d. 1916). An elder brother died in infancy. His paternal grandfather was a lawyer who died young, so that his father, then at Merchant Taylors' School, was orphaned at 16. He became a clerk in the Bank of England and remained there till he retired in 1894, having reached the status of Principal of the Bill Office.

Onslow has described his parents as typical Victorians, kindly, conscientious, prudent and old-fashioned, with strong religious feeling. The home was simple and sedate whilst the parents, like many others in those mid-Victorian days, exercised many economies for the benefit of their children.

Onslow was never a very robust boy and at the age of ten, for reasons of health, he was sent to Margate to school at Dane Hill House, known as Boulden's. Margate was then in the heyday of its fame as a place for preparatory schools and there was much competition among them at cricket and football. Onslow did well in taking prizes; but the most significant happening during his six years there was the formation of a chemistry class under H. T. B. Hodges, one of the assistant masters. The boys were provided with Barff's " Chemistry " and periodically witnessed the usual elementary experiments. Later, on Saturday afternoons he was sent to learn chemical analysis, at first from a Mr. Woodcock, and later to G. R. Tweedie, who introduced him to Valentin's " Qualitative Analysis." The early bias to chemistry was encouraged by a gift of a box of simple apparatus from a cousin which made experiments at home possible.

And so we find him in October 1888 entered at Finsbury, apparently on the advice of Mr. Dreaper, the father of W. P. Dreaper who, after finishing the course there, had just been appointed Chemist to Courtauld's silk-crape dyeing works at Braintree. He thus came under the influence of Castell-Evans and F. W. Streatfeild, teachers to whom so many chemists have paid tribute. Forster has written of the state of chemistry in these days in his 20th Streatfeild Memorial Lecture delivered to the Institute of Chemistry. He gained the Certificate after 2 years, being bracketed first, and spent a further year in Meldola's private research laboratory, his name being on a paper published by Meldola in 1891—" Researches in the triazine series."

Forster's wish was to enter industry as G. T. Morgan and others were doing, but his father felt that further training was desirable in spite of the serious monetary sacrifice which would be involved. He sought advice from many people and finally decided to send Onslow to Würzburg where Emil Fischer was making a great reputation.

It should be remarked that at this date there was no school of chemistry at either Oxford or Cambridge at all commensurate with their dignity as great Universities. Another factor was the necessity to a chemist of knowing German thoroughly.

Forster went to Würzburg in September 1891 where, after a short course of organic preparations, he was given the task of elucidating the structure of a hydroquinoline base produced when methylketole is heated with methyl iodide in sealed tubes. The work proved too difficult and after many months of unsuccessful experiments Fischer transferred him to a simple " Doctor-Arbeit " involving the condensation of methylketole with aldehydes and ketones. Fischer had by this time received the call to the Professorship at Berlin consequent on the death of Hofmann, so examination dates were advanced and Forster took his Ph.D. (*magna cum laude*) in July 1892.

The social and student life at Würzburg, with its free and easy customs, was a great awakening to Forster after the sedate atmosphere of Clapham and Finsbury. Here he met as fellow student Arthur W. Crossley and founded a life-long friendship which was to influence both men greatly. Life in the smaller German university towns in those days was cheap and convivial; the students played and worked hard and took readily to foreigners in spite of linguistic shortcomings. The material resources of the laboratory were little different from those at Finsbury, but for the first time he met a galvanic personality in Emil Fischer, then thirty-nine. Fischer at that time, as later in Berlin, visited and spoke to every student twice a day however unimportant their themes were and so impressed on them something of his enthusiasm and vitality. He was then at one of the most exciting stages of his sugar work and the atmosphere in the laboratory must have been tense. One of the writers had the same experience in Berlin eight years later when unswerving singleness of purpose was still Fischer's salient quality in life: he lived for his research work. Forster, Crossley, and those others who were privileged to work with him were infected and have retained for life that burning desire to add to knowledge by working at the bench.

---

* Reprinted by permission from *Obituary Notices of Fellows of the Royal Society*, Vol. 5.

M. O. Forster.

[*To face p.* 550

> " For giving me desire
> An eager thirst, a burning ardent flame
> That did incessantly a Paradise
> unknown suggest and something undescribed
> discern, and bear me to it; be
> Thy name for ever praised by me."
>
> TRAHERNE

Forster's debt to Fischer was in some measure repaid by the brilliant memorial lecture which he delivered to the Chemical Society in October 1920. He also paid homage to his teacher by his presence at the sixtieth birthday celebration in Berlin, which was by Fischer's desire an almost domestic affair.

On his return from Germany, after a few weeks in Meldola's laboratory, Forster went to Mason College, Birmingham, as private assistant to Professor W. A. Tilden. He remained there for nearly two years until July 1894. He speaks of the association as being a most happy and fortunate one; Tilden was not only kind at the time but consistently furthered his progress on subsequent occasions. Forster was fortunate in that he was stimulated by three such leaders as Fischer, Tilden, and Armstrong : as a consequence the love of work at the laboratory bench remained his dominant passion in life.

Here Onslow made friends with Sidney Williamson and J. H. Miller, also Emil Hatschek. He had a great capacity for life-long friendship with those he liked; to others he was distant and aloof, and in later years he had an air of superiority which did not make him generally popular. From Finsbury days he had liked Julian L. Baker—later he formed the closest association with G. T. Moody and W. J. Pope at the Central, also with G. T. Morgan whom he had first known at Finsbury but became specially intimate with when at the Royal College of Science. Those named, with A. W. Crossley, formed a closely knit band of friends able to help each other materially, and collectively to exert considerable influence in chemical, especially Chemical Society, circles.

At Birmingham Forster became practised in the art of making nitrosyl chloride and isoprene : he writes in his Streatfeild lecture how he sought occasional inspiration by respectfully gazing at a small bottle of colourless fluid submerging a sticky solid—the first ounce of rubber produced independently of the plant. He adds that it is true this transformation was never properly explained.

At this stage of his career Forster abandoned the idea of going into industry and realised that if he drifted into teaching he would require a London degree. Tilden had at this time transferred to the Royal College of Science in succession to T. E. Thorpe, who had gone to the Government Laboratory, and as Tilden could not find a place for him there Forster entered at the Central Technical College as a research student under H. E. Armstrong.

Thus in October, 1894, he first came to know Armstrong and the band of workers around him in an atmosphere of scientific endeavour which closely resembled that created by Emil Fischer. Forster found Armstrong most stimulating—he was set to work on camphor, then the chief subject of the laboratory research, undertaking in particular the study of the action of fuming nitric acid on camphor. Henceforth Forster, as we shall describe later, made camphor chemistry the chief study of his life.

At Christmas 1894 Forster was awarded the first Salters' Company's Research Fellowship of £150 a year at the Central. This was the first of this type of research fellowship; it was duplicated by the Leathersellers' Company and was due to Armstrong's representations to his life-long friends in these two great guilds. Few fellowships have been more productive of results—all the recipients have done most distinguished work largely in British industry, where they have attained the highest positions.

But Forster only held his Fellowship for a year, instead of the three years possible, being tempted by an offer from Tilden of a vacant junior demonstratorship at £100 per annum at the Royal College of Science. This was naturally against Armstrong's advice, who saw a much more brilliant career for Forster.

Christmas, 1895, began an association with the Royal College of Science which lasted for eighteen years until 1913, a period of outstanding scientific activity which placed him in the front rank of British organic chemists. At first he worked under J. W. Rodger, succeeding him as Senior Demonstrator in the South Laboratory on his death in 1897—Morgan then took Forster's place and the two collaborated, though not in research work, in greatest harmony until 1910.

Onslow owed much to the training of W. P. Wynne, a great believer in detail and accuracy and one of the neatest of manipulators, whom he succeeded as Assistant Professor in 1902.

Meantime Forster had overcome the various hurdles leading to the London Doctorate, which he took at the same time as Morgan in 1899 when he was awarded the Granville prize for his thesis.

The promotion to what was virtually a professorship in organic chemistry gave much greater facilities for research, including space, time, and help from advanced students. Forster was particularly fortunate in attracting a very brilliant Swiss—H. E. Fierz, who remained with him for four years. The association was a happy and valuable factor in the life of both; they published much first class work together; it led also to eight more Swiss coming to work under Forster. He had also a long list of English associates whose names are to be found on the published list of their joint papers.

The period 1902—1913 saw a broadening in Forster's activities. He was elected to the Royal Society in 1905 at the unusually early age of thirty-three and began to take a leading position in the administration of the scientific societies. He did much for the Chemical Society; elected a Fellow in 1892 he spoke often at the meetings of which he was a most regular attendant. Almost all his papers were contributed to it and they are notable for the clarity and brilliance of their exposition. This latter quality was not confined to the written word since it was generally regarded as a " field-day " when Forster read a paper at one of the meetings of the Society. After serving on the Council 1901—1904 he was Honorary Secretary during 1904—1910, Treasurer 1913—1933, and Vice-President 1910—1913. In 1918 the Society awarded him its highest distinction, the Longstaff Medal.

In 1905 the Annual Meeting of the Society of Chemical Industry took place in London under the presidency of Dr. William H. Nichols, a successful leader of chemical industry in the United States. His supporters included his wife and daughter Madeleine whom Onslow married in New York on January 1st, 1907. After this, Forster went every year to America, spending the summer at their summer home in the Thousand Islands, St. Lawrence River. For several years the marriage was a happy one but estrangement gradually became increasingly acute and the final disruption occurred in September, 1916. This was an overwhelming disaster for Onslow and one which had its effect for some years on his career.

In 1905 also Forster went to South Africa with the British Association, acting as one of the secretaries of the Chemistry Section. He was President of the Section at the Edinburgh meeting in 1921 where he delivered a brilliant address.

The future for a great school of organic chemistry at the Royal College seemed rosy, but there were clouds in the sky. Tilden retired in 1909 and Thorpe, now Sir Edward, came back as professor. He showed no sympathy towards the organic chemistry school, prescribing, for example, nine preparations as enough for the final course as compared with forty required by Fischer. Matters became even worse when H. B. Baker succeeded Thorpe for he had even less regard for Forster's subject. Morgan had gone to Dublin so Forster had to fight alone. The organic school at the Central had also been shut down when the City Guilds College was absorbed by the Imperial College. Forster resigned, a disappointed man, turning his attention for a change to politics, hoping, if elected, to represent science in Parliament and fight for its recognition. He was adopted prospective Conservative candidate at Blackburn and nursed the constituency for three years taking an energetic interest in the work.

In 1914 came the war and Forster like many others tried to get something useful to do. The dye-using industry was in chaos for they had insisted on purchasing all their dyes abroad and found their supplies cut off. In the spring of 1915 Mr. James Falconer, who had been charged by the Government with the Chairmanship of British Dyes Ltd., offered Forster the Chairmanship of the Technical Committee of the Company which had purchased the Huddersfield dyestuffs factory of Read Holliday and Sons. He became a Director in 1916.

Few subjects have aroused greater controversy and personal disagreements than the conduct of the dyestuff industry at this period, so that it is preferable to avoid it here. Forster and his colleagues resigned in 1918. His activities were not confined to the technical side of the industry: he was mindful of the importance of social amenities for the staff, being responsible for the first staff club at Huddersfield.

During 1918 the Worshipful Company of Salters had discussed the idea of directing part of their income to the encouragement of chemistry and its application to industry. Their plans matured and in December 1918 Forster was appointed Director of the Salters' Institute of Industrial Chemistry with an office attached to the Company's hall in St. Swithin's Lane. Here a large number of young ex-officers and others, whose chemistry training had been interrupted by the war and who desired to resume it, assisted by Salters' Fellowships, were interviewed. Meanwhile Forster, assisted by W. B. Saville, retained a place at the Davy–Faraday Laboratory, where he continued his research work choosing as subject the constitution of picrorocellin. The original appointment by the Salters' Company had contemplated the construction of laboratories, but it became clear after 3 years that the rebuilding scheme would not take shape. So Forster agreed to a reduced salary so as to have his afternoons free for the laboratory in Albemarle Street.

It is opportune to praise here the enterprise of the Salters' Company not only in giving many young men the chance to complete their training in some degree of financial comfort but also in engaging the help of leaders of experience to advise them in their enlightened tasks. Forster's experience both as a teacher and in industry undoubtedly proved of the greatest value. He was followed, as is well known, first by Professor Smithells and later by Sir Robert Robertson.

Forster's father was a dyer, and Onslow became a Liveryman of the Guild in 1894. He reached the Court in 1913, was Renter Warden in 1918—1919 and Prime Warden in 1919—1920. As Renter Warden he was instrumental in adding to the Livery twenty new members distinguished in the dyeing and dye-making industries; until then he had been the only member of the Company even remotely connected with the craft it represents.

Addison desired his readers to consider the world in its most agreeable aspects. In many respects this was Forster's attitude. Tall and good looking, surrounded by influential friends, life was easy for him for many years. His working bench was his first loyalty; he largely controlled the Chemical Society for many years and gave a helping hand to the other chemical societies—he was one of the founders of that much-needed body, the Association of British Chemical Manufacturers, at the end of the last war, which has since played so prominent a part in the establishment of a powerful and progressive chemical industry in this country.

In his few general addresses he shows an assurance of the fact that we discover the perplexities of the world and propound the problems only to find that we must ourselves supply the answers. Yet in general he was not prepared to break a lance for progress notwithstanding his professed parliamentary aspirations. Forster did his best work in his Indian phase, which we are about to chronicle—in England he failed to become the leader which he might have been expected to be with the unusual opportunities vouchsafed him. His own early years were drab enough and attended with sufficient severity of circumstance to elicit his latent powers.

Some account must now be given of the great service which Forster, as Director of the Indian Institute of Science, was able to render to the development of scientific research in India. But first it is necessary to recount briefly the history of this Institute. It owes its origin to the foresight and munificence of Mr. J. N. Tata, a Bombay industrialist who in 1896 offered to endow a trust with Rs. 30 lakhs for the encouragement of research in India. At this time the teachers in the Indian universities, which were modelled on the University of London, had, with a few notable exceptions, done little to advance knowledge. Mr. Tata recognised that if India was to attain a position worthy of her past this must be based on research. After taking the advice of Sir William Ramsay, Sir David Orme Masson, and Colonel Clibborn, it was decided to build a Research Institute on a site made available by the Government of Mysore some three miles from the outskirts of Bangalore. Mr. Tata did not live to see his plans come to fruition, but his sons, Sir Dorabji and Sir Ruttonji Tata, gave full effect to his wishes. In 1906, on the recommendation of the Royal Society, Dr. M. W. Travers was appointed the first Director and he designed the fine buildings which now house the Institute. The first students were admitted to the Departments of General Chemistry, Applied Chemistry, and Electrical Technology in July 1911, the Organic Chemistry Department being opened in September of that year. The intention of the founder was that the Institute should not only impart advanced knowledge and instruction in the methods of research but that it should also assist in the development of Indian industry.

Unfortunately the early days of the Institute were not free from controversy and in 1914 Dr. Travers resigned. The outbreak of the 1914—1918 war naturally interfered with the appointment of a new Director from England and Sir Alfred Bourne, a distinguished biologist, who had retired recently from the position of Director of Public Instruction in Madras, consented to fill the vacancy. This position he held until 1921 when the Visitor, the Viceroy, prior to filling the vacancy appointed a committee of enquiry, with the late Sir William Pope as chairman, to report on the working of the Institute. In their report the committee, in addition to proposing new regulations and by-laws, recommended that the new Director should be a " scientific man of eminence and of proved administrative ability . . . steeped in scientific modes of thought and scientific aspirations."

It was natural that Pope, who was consulted on the appointment of the new Director, should find just these qualities in his friend of the Central days who had in addition a fine presence and the requisite social qualities. Forster's acceptance, at the time of his 50th birthday, involved no small personal sacrifice. It meant the cessation of his work at the laboratory bench and the severance of the close ties which bound him to the scientific life of the metropolis. He recognised, however, that it offered him the opportunity of serving science in a different manner and history may well think that the eleven years during which he was Director enabled him to make his most lasting contribution to science. He had been warned that his reception might not be too cordial and in fact certain members of the staff were hostile to his appointment. One organ of the Press called him " a white elephant." As those who knew Forster had anticipated, he rapidly reached the most cordial relations not only with the staff but, what was of even greater importance, with the students. He was able through the generosity of Sir Dorabji Tata to build for them a spacious club house with a billiards table, library, and indoor games, whilst six tennis courts and a cricket field provided facilities for outdoor recreation. He himself made full use of the club; he played tennis there regularly and on two occasions he won the billiards handicap. In his own home the students were always welcome and he entered very fully into their life. The amicable relations established between the staff and students had their natural outcome in the high standard of research carried out in the laboratories so that competition for admission then became keen. The great contribution which the Institute has been able to make to the world war effort shows that the tradition has been maintained and this was a source of much satisfaction to Forster.

In the first few years after his appointment he continued to supervise the work of a few research students but later, under the burden of his administrative duties and owing probably also to the somewhat enervating climate of Bangalore, he left this to the head of the organic chemistry department. His keen interest in original work remained undiminished and he never failed to attend the meetings of the colloquia where his sage council was much appreciated. He also edited the Journal of the Institute.

When Forster first went to Bangalore he found there the following Professors : J. J. Sudborough (Organic Chemistry), G. J. Fowler (Biochemistry), H. E. Watson (Inorganic Chemistry), and Alfred Hay (Electrical technology). Professor J. K. Catterson Smith replaced Hay in 1923, R. V. Norris came instead of Fowler in 1924, whilst J. L. Simonsen followed Sudborough in 1925. When in 1927 a lecturer was appointed to each of the four departments promising young Indians were appointed in each instance. The team was a first-class one : it enabled Forster to give an increasing amount of his time to administrative and social matters and so further the prestige of science in India.

In December 1925 Onslow married again, to Mrs. Elena Hayes Parodi, widow of a barrister of Gibraltar, whom he had first met in Granada during a visit to Spain with G. T. Morgan in 1901. Her first husband died in 1922 and she spent three years in California until she joined Onslow in India.

Forster took the opportunity of the annnal meetings of the Indian Science Congress to visit various parts of India and he was President of the Benares meeting in 1925. To these meetings he had always something of value to contribute and few who were fortunate enough to attend the Lahore meeting in 1926 will forget the speech which he made at the annual dinner.

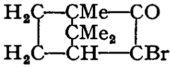
Forster should have retired in 1927 but at his own request he was re-appointed for a further three years when he was asked by the Council to continue for a further period of two years, finally retiring in March 1933. In conferring a knighthood when he retired, the Governmant of India not only honoured him but themselves. On his retirement, guided by his wife's wish for sunshine, he went to live in Mysore City in a house which had been placed at his disposal by the Maharajah of Mysore and which the industry and imagination of his wife and step-daughter Carmen converted into a picturesque and comfortable home. Deeply attached as Forster was to India—in one of his last letters he referred to it as " this dear old country "—there is little doubt that he himself would have preferred to have returned to England. Lady Forster wished, however, to remain in India and they only paid occasional visits to the home country, the last being in 1939. After Lady Forster's death in 1941 his life was somewhat lonely, brightened only by visits from his step-daughter Carmen who had married Sir Donald Field, and their young son, and by Forster's adopted son, Francis, a Flying Officer stationed in Ceylon. To the end he continued to follow the advancement of science and a reprint of his last article in *Current Topics*, a eulogistic review of Professor A. V. Hill's report on his Indian visit, reached this country shortly after his death. He had made preparations to return to England when the conditions of travel permitted, but his sudden and peaceful end prevented the old friends from seeing him again in the familiar haunts at the Athenaeum and Burlington House.

Reference has already been made to Onslow's capacity for making a few intimate friends in his own subject with whom he continued to correspond to the end of his life. They saw much of each other, travelled abroad together, helped one another wherever possible, and in every way exercised powerful influence as a group. Hence the view, a false one, held by outsiders that he was distant and unapproachable. As he grew older the reverse was true—he enjoyed his clubs, a game of bridge, and conversation both with his peers and with younger men. His social gifts contributed greatly to the success of his Indian career. Those of us who battle to the end of life so as to continue to achieve in this harsh, invigorating climate should perhaps make allowances for the will to take things more easily under the Indian sun.

Scientific Work.

Forster was essentially an experimentalist and he had little interest in the theoretical aspects of chemistry. His only contribution to theory, a paper with F. P. Dunn (*J.*, 1909, **95**, 425) entitled " An interpretation of the Hantzsch–Werner hypothesis," was of minor importance. His first paper (with Meldola, *J.*, 1891, **59**, 59) dealt with a subject which was, at the time, of some importance, namely, the structure of the triazenes. Evidence was adduced that these were cyclic bodies and not hydrazones as had been suggested by Goldschmidt and his collaborators (*Ber.*, 1890, **23**, 505; 1891, **24**, 1000, 2300). His second paper, also with Meldola (*Proc.*, 1893, **9**, 7), recorded a convenient method for the preparation of a dinitro-α-naphthylamine. With Tilden he published three papers (*J.*, 1893, **63**, 1388; 1894, **65**, 324; 1895, **67**, 489) which dealt with the compound formed by the interaction of α-pinene with picric acid and with the addition of nitrosyl chloride to unsaturated compounds. It was to H. E. Armstrong, however, that Forster owed his introduction to the field of research to which he was to devote most of his active life. Armstrong was at the time greatly interested in the chemistry of camphor, and he suggested to Forster that he should investigate the action of nitric acid on αα'-dibromocamphor (I). Contrary to expectation the product was found to contain no nitrogen but was a lactone, dibromocampholid (II). Although, since the constitution to be assigned to camphor was still debatable, Forster could not assign a definite structure to dibromocampholid and the various substances which he prepared therefrom, this paper provides early evidence of Forster's experimental skill. Lapworth and his collaborators (*J.*, 1899, **75**, 992, 1134; 1900, **77**, 311; 1902, **81**, 17), also working under Armstrong's inspiration, were able to complete the work so ably commenced by Forster.

(I.)



(II.)

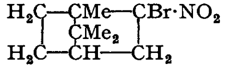
Forster next directed his attention to camphoroxime (*J.*, 1897, **71**, 191, 1030; 1899, **75**, 1141), a substance which was to provide him with problems to occupy his attention for many years. His earlier work, concerned with attempts to prepare the α-bromo-derivative, was unsuccessful, but he made two observations of some interest. Treatment of the oxime with methyl iodide gave methyl camphorimine in place of the expected methyl ether, whilst by the action of potassium hypobromite a substance of the formula $C_{10}H_{16}O_2NBr$ was obtained to which further reference is made below.

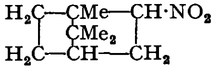
By reduction of the oxime with sodium in amyl alcoholic solution a convenient route to bornylamine was provided (*J.*, 1898, **73**, 386; with Hart-Smith, *ibid.*, 1900, **77**, 1152). He was thus able to show that the base previously prepared by Leuckart and Bach (*Ber.*, 1887, **20**, 104) by the action of amyl formate on camphor, followed by hydrolysis of the formyl derivative, was a mixture of the two isomeric bases, bornylamine and *neo*-bornylamine. Both these were fully characterised and in two subsequent papers (*J.*, 1899, **75**, 934, 1149) he drew attention to the effect of substitution and unsaturation on the optical rotatory power of these bases.

The marked effect of unsaturation on the rotatory power of camphor derivatives continued to interest Forster and in later papers (with Thornley, *J.*, 1909, **95**, 942; with Spinner, *ibid.*, 1919, **115**, 889) he discussed the remarkably high rotatory power of bisiminocamphor derivatives and in *p*-phenylenebisiminocamphor he recorded the highest rotatory power, $[\alpha]_D + 1509°$, for any substance known at the time.

In 1900 (*J.*, **77**, 251) the first paper entitled " Studies in the Camphane Series " appeared, Part XLI published in 1926 forming the subject of his last scientific memoir. It was mentioned above that by the action of potassium hypobromite on camphoroxime a substance of the formula $C_{10}H_{16}O_2NBr$ was formed. This was now shown to be bromonitrocamphane (III) and from this by the action of alcoholic potassium hydroxide two isomeric 1-nitrocamphanes (IV) were prepared, whilst the removal of hydrogen bromide from (III) gave a nitrocamphene which may be represented by (V) or (VI).

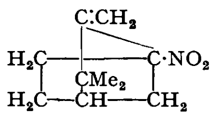
(III.)

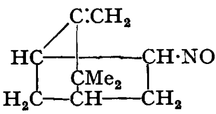




(IV.)

(V.)



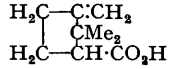


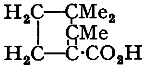
(VI.)

Unfortunately Forster did not determine whether his nitrocamphene was a *s*- or *t*-nitro-compound and since he was at the time unaware that the reaction involved a Meerwein–Wagner rearrangement he naturally concluded that it was a derivative of camphane. The reactions of bromonitrocamphane (III) and of nitrocamphene (V or VI) formed the subject of three further communications (*J.*, 1901, **79**, 544, 643; with W. A. Roberts, *ibid.*, p. 1003) in which the anhydrides of bromonitrocamphane, hydroxycamphene, and aminocamphene were described. Hydroxycamphene was found to undergo a remarkable change on treatment with bromine being converted into β-bromocamphor (*J.*, 1902, **61**, 264), a substance prepared more readily from Reychler's camphorsulphonic acid (Armstrong and Lowry, *J.*, 1902, **81**, 1462).

A further interesting observation was the conversion of bromonitrocamphane (III) into an unsaturated liquid acid, *infra*campholenic acid, by the action of aqueous sodium hydroxide. For this acid Forster (*J.*, 1901, **79**, 162) suggested the structure (VII) since it was isomerised by sulphuric acid to *iso*laurolonic acid (VIII). This formula for *infra*campholenic acid has since been shown to be correct.

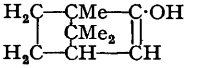
(VII.)



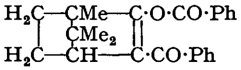


(VIII.)

Forster was not unnaturally at first under the impression that his hydroxycamphene represented the enolic form of camphor (IX). He attempted therefore to prepare derivatives of this enolic form and in his first communication on this subject (*J.*, 1901, **79**, 987) he described the preparation of a dibenzoate by the action

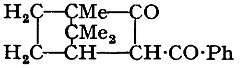


(IX.)

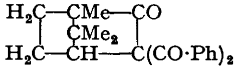


(X.)

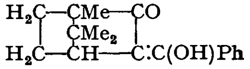
(XI.)



(XII.)



(XIII.)

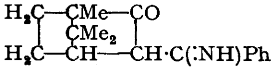


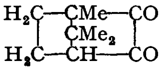
(XIV.)

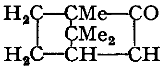
of benzoyl chloride on sodiocamphor. This he represented by (X) and the monobenzoate, obtained on hydrolysis, by (XI) which on digestion with formic acid passed into benzoylcamphor (XII). Later, however (*J.*, 1903, **83**, 98) he was able to show that the dibenzoate was actually (XIII) and the monobenzoate (XIV) since the latter gave on oxidation with chromic acid camphorquinone and on reduction benzylidene- and benzyl-camphor. The chlorination, bromination, and nitration of benzoylcamphor was also studied (with Micklethwait, *J.*, 1902, **81**, 167; with Jenkinson, *ibid.*, 1903, **83**, 537) when substitution occurred on the α-carbon atom. A further interesting observation was the formation of iminobenzoylcamphor (XV) by the action of ammonium formate on benzoylcamphor. This substance was prepared later (with Judd, *J.*, 1905, **87**, 372) by the action of phenylmagnesium bromide on α-cyanocamphor.

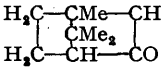
In 1903 (*J.*, **83**, 514) Forster commenced his study of the dioximes of camphorquinone and he isolated an unstable form of *iso*nitrosocamphor. This opened a field of research which was to be Forster's most outstanding contribution to the chemistry of camphor and incidentally formed the subject of his last scientific communication (with Rao, *J.*, 1926, 2670). Camphorquinone (XVI) can give rise to four monoximes represented by the abbreviated formulæ (XIX), (XX), (XXI), and (XXII). These are derived respectively from camphor (XVII) and *epi*camphor (XVIII).

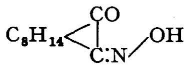
*iso*Nitrosocamphor was first prepared by Claisen and Manasse (*Annalen*, 1893, **274**, 530) by the action of *iso*amyl nitrite on sodiocamphor. Forster was able to show that the stable form, m. p. 152°, was accompanied by an unstable form, m. p. 114°. The two derivatives are apparently present in approximately equal quantity but it remained for Forster and Rao to devise a convenient method for their separation. Forster (*J.*, 1905, **87**, 232) established the configuration of the two oximes assigning the *syn*-structure (XIX) to the stable form, m. p. 152°. This has since been shown by Meisenheimer and Theilacker (*Annalen*, 1930, **493**, 33) to be, in accordance with modern theory, the *anti*-form (XX). Later the two *iso*nitroso*epi*camphors (XXI) and (XXII) were prepared simultaneously by Bredt and Perkin (*J.*, 1912, **101**, 1348) and by Forster and Spinner (*ibid.*, p. 1340). The configurations of these (stable form, m. p. 174°, and unstable form, m. p. 112°) were also determined; the former must now, however, be regarded as the *anti*- and not the *syn*-form as Forster postulated. Corresponding to the four monoximes of camphorquinone there are four dioximes which were all prepared by Forster and his collaborators, and in a remarkable memoir (*J.*, 1913, **103**, 3664) their configurations and their relationship to the monoximes were discussed. Whilst these configurations now require modification in the light of Meisenheimer's work the value of Forster's contribution remains undiminished and this must be regarded as Forster's greatest scientific paper.

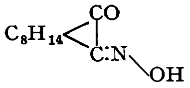

(XV.)

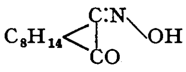

(XVI.)

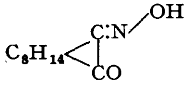

(XVII.)


(XVIII.)


(XIX.)

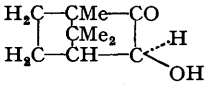

(XX.)

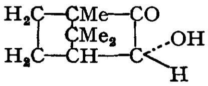

(XXI.)

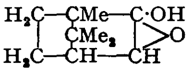

(XXII.)

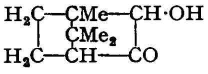
With various collaborators (with Zimmerli, *J.*, 1910, **97**, 2156; 1911, **99**, 478; with Kunz, *ibid.*, 1914, **105**, **718**; with Saville, *ibid.*, 1920, **117**, 353) he extended his observations to the hydrazones, semicarbazones, hydrazo-oximes and oxime-hydrazones of camphorquinone and although they did not in all cases succeed in preparing all the possible isomerides they record reactions of very considerable interest.

In concluding our consideration of Forster's contributions to the chemistry of camphor reference must be made to one of his last papers (with Shukla, *J.*, 1925, **127**, 1855). By the reduction of camphorquinone with zinc dust in acetic acid solution Manasse in 1897 (*Ber.*, **30**, 689) had obtained two hydroxycamphors, which he regarded as the stereoisomerides (XXIII and XXIV). Whilst the first of these, α-hydroxycamphor, was undoubtedly a true hydroxycamphor (Lapworth and Chapman, *J.*, 1901, **79**, 382), Forster and Shukla, in agreement with Karrer and Takashima (*Helv. Chim. Acta*, 1925, **8**, 242), suggested that the β-form was actually the oxide (XXV). This suggestion was finally disproved by Bredt and Fischer (*J. pr. Chem.*, 1931, **131**, 49) who showed it to be a hydroxy*epi*camphor (XXVI).

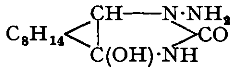

(XXIII.)

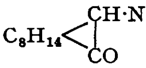

(XXIV.)


(XXV.)


(XXVI.)

Whilst retaining his interest in the chemistry of camphor Forster in 1908 broke completely new ground when he opened, in collaboration with Fierz, a series of communications entitled "The Triazo-group." This work, which in the short space of four years formed the subject of twenty-one memoirs, originated in the observation of Forster and Fierz (*J.*, 1905, **87**, 826) that camphoryl-ψ-semicarbazide (XXVII) (*ibid.*, p. 722) on treatment with nitrous acid gave camphorylazoimide (XXVIII). This substance was unique, since, although many triazo-compounds had been prepared previously, this was the first triazo-ketone to be described, whilst triazo-derivatives of acids, aldehydes, and alcohols were unknown. It was true that Curtius and Lang (*J. pr. Chem.*, 1888, **38**, 532) had recorded a triazoacetic acid but this had been shown later to be a bimolecular polymeride of diazoacetic acid.

(XXVII.)


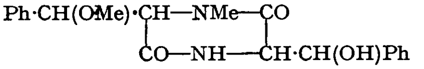

(XXVIII.)

In their first communication (*J.*, 1908, **93**, 72) Forster and Fierz described the preparation of triazoacetic acid and triazoacetone, the method of preparation being to treat ethyl chloroacetate and chloroacetone respectively with sodium azide. This facile method of preparation was found to be of general application and a large number of mono- and bis-triazo-compounds were prepared and their reactions studied in great detail. Reference need only be made to three of these which Forster himself considered to be of peculiar interest, namely, the optically active modification of α-triazopropionic acid (with Fierz, *J.*, 1908, **93**, 1859) and the nitrosoazides of α-pinene and α-terpineol prepared by the action of sodium azide on the corresponding nitrosochlorides (with Newman, *J.*, 1911, **99**, 244).

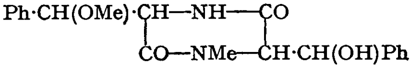
Whilst the explosive character of these compounds was recognised they appeared to have considerable stability. They could, when necessary, be purified by distillation under diminished pressure and analysed in the usual manner, and Philip (*J.*, 1908, **93**, 918) had determined the refraction and dispersion of many of them. However, in 1912 a disastrous explosion led to the cessation of work in this field. In collaboration with Withers (*J.*, 1912, **101**, 489) Forster had prepared αγ-bistriazopropylene, $N_3CH_2{\cdot}CH{:}CHN_3$, by the action of alkali on αγ-bistriazo-β-chloropropane. The oil had been purified by distillation and its physical constants determined by Philip. On weighing out material required for the repetition of a nitrogen determination a violent explosion occurred and Dr. Withers was very seriously injured. In later years Forster used to tell with amusement of how he got rid of his specimens of triazo-compounds by dropping them from the windows of the Royal College of Science after his first attempt at destruction by dropping a kilogramme weight on to a specimen in a bucket of water had resulted in serious damage to the laboratory floor.

When Forster resumed work in the Davy–Faraday Laboratory at the Royal Institution in 1919 he came into possession of collection of chemical materials which, on the death of Mr. C. E. Groves, had been presented to the Royal Institution by the Misses Groves. Amongst these was a substance, picrorocellin, which had been obtained by Stenhouse and Groves (*Annalen*, 1877, **185**, 14) from the lichen, *Roccella fuciformis*, coming probably from the west coast of Africa. In collaboration with Saville (*J.*, 1922, **121**, 816) he was able to show in an elegant investigation that this substance, which had the composition $C_{20}H_{22}O_4N_2$, was the diketopiperazine derivative represented by either (XXIX) or (XXX). It was suggested that this compound was formed

(XXIX.)



$$\begin{array}{l}\mathrm{Ph{\cdot}CH(OMe){\cdot}CH{-}NMe{-}CO}\\ \qquad\qquad\quad\ \mathrm{CO{-}NH{-}CH{\cdot}CH(OH)Ph}\end{array}$$



$$\begin{array}{l}\mathrm{Ph{\cdot}CH(OMe){\cdot}CH{-}NH{-}CO}\\ \qquad\qquad\quad\ \mathrm{CO{-}NMe{-}CH{\cdot}CH(OH)Ph}\end{array}$$

(XXX.)

in the lichen by the intermolecular condensation of the two α-amino-acids, α-methylamino-β-methoxy-β-phenylpropionic acid and α-amino-β-hydroxy-β-phenylpropionic acid (phenylserine), or the corresponding acids in which the *N*-methyl group is transposed. In preliminary experiments, which had as their subject the synthesis of picrorocellin, Forster and Rao (*J.*, 1926, 1943) prepared the *cis*- and *trans*-modifications of phenylserine, but they were unsuccessful in attempts to convert these into a diketopiperazine derivative.

It is unfortunate that Forster with his remarkable powers of expression and exposition had so few opportunities of reaching a larger public, but he took full advantage of those which he had. As President of Section B at the Edinburgh meeting of the British Association in 1921 he delivered a brilliant address. Although this dealt with the recent advances of chemistry in the realm of the most complex of natural products, including chlorophyll and the anthocyanins, he succeeded in so presenting the facts that they cannot have failed to interest the audience and to have illustrated to the " common man " how important was the study of chemistry. His Benares address to the Indian Science Congress was in a more philosophic vein, the value of the study of science for all mankind. It shows Forster to have been not only a man of science but also a fine scholar.

E. F. ARMSTRONG.
J. L. SIMONSEN.

BIRAJ MOHAN GUPTA.

1890—1945.

DR. BIRAJ MOHAN GUPTA, Deputy Public Analyst to Government, United Provinces, died on May 26th, 1945, after a brief illness, at the Kharagpur residence of his eldest son, Capt. A. K. Gupta, Assistant Engineer, B.N. Railway.

Gupta was born in a village in Bengal on October 28th, 1890, and received his early education at Calcutta. After graduating from the Calcutta University, he migrated to Lucknow and studied in the Canning College from where he took the M.Sc. degree of the Allahabad University in 1914. Thereafter, he worked with Professor P. S. MacMahon on the " Composition of Milk at Lucknow," the results of which were published by the U.P. Government in the form of a printed booklet. Gupta worked as a teacher of Chemistry in the Lucknow Christian College for a while and on the introduction of the U.P. Prevention of Adulteration Act in 1915 he was appointed Assistant to the Public Analyst to Government, U.P. On the outbreak of the First World War, when Professor MacMahon went on active service, Biraj Mohan was appointed Assistant Professor of Chemistry in the Canning College, Lucknow, and also continued to be part-time Assistant Public Analyst to Government, United Provinces. In 1920 he proceeded to London to work under Professor Jocelyn F. Thorpe, and in the same year he was elected a Fellow of the Society, and became an Associate of the Institute of Chemistry. He obtained the Ph.D. degree of the London University, and published two papers in the *Journal*, on " An Investigation on the Influence of Negative Groups of Different Character on the Reactivity of Hydrogen Atoms Carried by the same Carbon Atom " and on " Formation of Bromine Derivatives of Carbon Compounds without the Production of Hydrogen Bromide ".

On his return to India in 1922, he was appointed a Reader in the Lucknow University, which post he continued to hold until 1929. During this period he also worked as part-time Assistant Public Analyst to Government, U.P.

On the reorganisation of the U.P. Government's Public Analyst Department in 1929, Dr. Gupta resigned his appointment in the University and became whole-time Deputy Public Analyst to Government, U.P., which office he continued to hold until the time of his death.

As a member of the Central Committee for Food Standards of the Government of India, Dr. Gupta has done valuable work in standardising foodstuffs in India. Among other publications, mention may be made of

" A note on the use of saccharine as a sweetening agent from the point of view of public health," printed in the Indian Medical Gazette, Vol. LXX, No. 9 (Sept., 1935).

Dr. Gupta, in collaboration with other assistants, worked on various problems connected with the analysis of foodstuffs, and read papers in the Indian Science Congress on many occasions.

An unassuming and quiet person, Dr. Gupta possessed a lovable temperament. He took keen interest in many spheres of activity, such as the Rotary movement. He was closely connected with the management of several educational institutions in Lucknow and was associated with many social organisations.

S. C. ROY.

ALFRED LUCAS.

1867—1945.

ALFRED LUCAS was born on 27th August, 1867, at Manchester. There is little available information concerning his early years, and Lucas rarely referred to them. He received his training at the Royal College of Science, and served as Assistant in the Government Laboratory for seven years. During this period he lectured for a short time at Birkbeck College. He became later a Fellow of the Royal Institute of Chemistry.

Having contracted tuberculosis, Lucas, on medical advice, went to Egypt in 1897. His health sufficiently recovered in the following year to allow him to become chemist to the Egyptian Salt and Soda Company under Mr. A. H. Hooker, known to Fellows of the Chemical Society as the donor, in 1930, of the mace. In 1899, Colonel (later Sir) Henry Lyons, Director of the Geological Survey Department, appointed Lucas chemist-in-charge of the small laboratory established by him chiefly for the analysis of Egyptian minerals. The work carried out in this laboratory rapidly increased in scope until all building materials and materials purchased by the Egyptian Government were analysed for compliance with the detailed specifications drawn up by Lucas. Later, the Egyptian Assay Office was attached to the laboratory and a Petroleum Section added to deal with oil investigations and royalties. Thus, Lucas established the present Egyptian Government Chemical Department of which he was Director until 1923. This Department was most efficiently staffed and, for the help given by it to the military authorities during 1914—1918, Lucas was awarded the O.B.E. He also received the Third Order of the Nile and the Fourth Order of the Osmania.

On his retirement, Lucas was able to take up the work in which he was most keenly interested, *viz.*, the application of chemistry in criminal and archæological investigation. He became chemist to the Antiquities Department and, as an essentially individualistic worker, he was much happier and even more successful than he had been as Director of a large Chemical Department. All his work was carried out with meticulous care and attention to detail, and his " Forensic Chemistry and Scientific Criminal Investigation " (a reprint of the fourth edition appeared after his death) affords evidence of Lucas's methods of solving problems and of his originality. This book will remain a standard on the subject for a considerable time.

Lucas created for himself a unique position in archæology, and especially in Egyptology. Almost from the time of his first arrival in Egypt, Lucas decided to make his home there, and Egyptology and archæological exploration in Egypt became his chief study. He wrote most interesting little books on " The Route of the Exodus " and on the history of Egypt and Libya and he was ready to make full use of the wonderful opportunity when his services were lent, in 1932, to (the late) Howard Carter for cleaning and preserving the huge wealth of objects found in the tomb of Tutankh-Amen (see " Chemistry of the Tomb ", " The Tomb of Tutankh-Amen ", vols. 2 and 3 by Howard Carter).

Probably Lucas's most important book was " Ancient Egyptian Materials and Industries " In this fully documented and accurate work, Lucas did not hesitate to comment severely on mis-statements of previous writers. His " Antiques, Their Restoration and Preservation " incorporated his own practical experience as a chemist in this field. Lucas's unexpectedly long life was full of interest and this interest he willingly shared. His chief work was his own hobby and it was extremely well done. He was a chemist and a truly learned man, ever ready to place his amazingly detailed knowledge at the disposal of all who sought it.

He died, as he would have wished, in Luxor, on 10th December, 1945; he was about to attend a Commission on the Theban Tombs.

C. S. GIBSON.

FREDERIC WILLIAM ROBINSON.

1889—1946.

FREDERIC WILLIAM ROBINSON, elder son of the late Mr. and Mrs. Joseph Robinson of Grove House, Farnworth, near Widnes, recently died at Short Hills, New Jersey, U.S.A.

F. W. Robinson was born at Farnworth in 1889 and was educated at Widnes Secondary School and Liverpool University where he graduated with First Class Honours in the School of Chemistry and later obtained the M.Sc. degree in the same University. He won the Sir John Willox Research Scholarship and went to Germany to research in physical chemistry under Professor Haber at Karlsruhe. On the completion of this work he joined the firm of W. C. Heraeus at Hanau a. Main, where he developed the production of clear fused silica ware, and the manufacture of quartz mercury vapour lamps.

In 1912 he went to the United States at the foundation of Hanovia Chemical and Manufacturing Co., of Newark, New Jersey, an associated company of the Heraeus firm. He was made a director of this company in 1916, and in 1919 he joined the Board of the parent firm, and founded the Hanovia Quartz Lamp Company at Slough in this country.

Robinson was a well known member of the American Chemical Society, which has published some of his work, especially that in connection with air sterilisation for operating theatres and other places where sterile air is necessary. He took a great interest in the public affairs of Newark, New Jersey, and in its commercial development, having been President of the Chamber of Commerce of that city.

In 1917 Robinson married Marguerite Imfeld, an American girl of Swiss parentage, and her death in 1944 had a very depressing effect on his health. He is survived by three daughters.

D. G. BARKLA.

FREDERIC SWARTS.

1866—1940.

SWARTS, an honorary fellow of our Society, was rightly considered one of the leading Belgian scientists and had won a well-deserved reputation by his fundamental researches on organic fluorine compounds.

He was born in 1866 at Ghent at the time when his father was assistant at the university to Kekulé, whom he succeeded in the following year. At Ghent, Frederic Swarts received the degrees of Doctor in Natural Sciences in 1889, and Doctor in Medicine in 1899. He became assistant to his father, and from 1912 assumed the whole charge of teaching chemistry to beginners and advanced students at the university until his retirement in 1936.

His first paper was published in 1889 in the *Bulletin de l'Académie royale de Belgique*, where most of his work may be found; other papers were published in the *Bulletin de la Société chimique de Belgique* after 1912, and in the *Journal de Chimie physique* from 1919 onwards.

As far back as 1891, he could claim the synthesis of a new organic fluorine compound, trichlorofluoromethane; from then on, his discoveries in this line became more and more numerous. Such researches had long been hampered by the very great affinity displayed by fluorine for carbon and hydrogen and also by the difficulties and dangers inseparable from work with anhydrous hydrofluoric acid. Swarts was able to find a new method of approach by the use of other fluorinating agents..

Already, in 1892, he had shown that antimony trifluoride is particularly suitable, and in 1896 he began to use mercurous fluoride.

His first syntheses were made on a series of halogen derivatives of methane and ethane with different halogens in the same molecule, and the corresponding ethylenic derivatives; later, he synthesised racemic chlorobromofluoroacetic acid and monofluoroacetic acid. But by this method it was not possible to prepare compounds with three fluorine atoms on the same carbon; success here was achieved by the action of antimony trifluoride on phenylchloroform. From phenylfluoroform, ω-trifluoro-*o*-toluidine was prepared; this by careful oxidation gave trifluoroacetic acid, the strongest of all organic acids. Later Swarts succeeded in preparing trifluoroacetylacetic acid, the only keto-acid stable enough to be distilled without decomposition; he prepared also trifluoroacetone, trifluoroethyl alcohol, and hexafluoroethane. Finally, by diazotisation in concentrated hydrofluoric acid, he introduced fluorine into the aromatic ring itself.

Having at hand a great variety of organic fluorine compounds, Swarts pressed on with dogged perseverance in their study from the chemical as well as from the physico-chemical point of view. He showed for instance that the strength of the carbon–fluorine link explains the stability of fluorine compounds towards metals, bases, and water, and their inactivity to glass; it also explains the possibility of hydrogenating trifluorotoluene to trifluoromethyl*cyclo*hexane. The affinity of fluorine for hydrogen is apparent from the ease of the dissociation of secondary alkyl fluorides and the hydrogenation of compounds containing fluorine in the benzene ring, both with the loss of hydrofluoric acid.

In 1919 Swarts published an important contribution to the thermochemistry of more than sixty fluorine compounds. Besides adapting a very difficult technique, this research led to many interesting theoretical conclusions. The inner structure of the fluorine atom results in the narrowness of its external sphere of attraction and explains the remarkable volatility of its organic derivatives; difluoroacetic acid boils 45° lower than acetic acid, and trifluoromethyl cyanide 143° lower than methyl cyanide.

In 1923 came an important work on the refractometry of fluorine compounds; the molecular refraction of such derivatives was found to be lower than for the corresponding hydrocarbons; the atomic increment of fluorine was smaller than that of all other elements, even hydrogen. Finally, in 1931, he measured the viscosities of the same compounds.

During his forty years of research, Swarts had prepared many other halogen derivatives in a state of high purity and carefully determined their properties, so as to have the necessary materials for comparison with the corresponding fluorine compounds.

His ability as a teacher was of a high standard, as shown by the number of his pupils and the quality of his " Traité de Chimie minérale et organique."

Member of the Académie Royale de Belgique since 1904, holder of the decennial prize for chemistry and physics in Belgium for the period 1909—1918, chairman of the Belgian National Committee for chemistry since its inception, of the Belgian Chemical Society, of the Solvay International Congress, corresponding member of the Institut de France, honorary member of the Royal Institution of Great Britain, etc., he was also the holder of many honorary degrees.

As a scientist, Swarts will be remembered as having during the last fifty years promoted to the highest degree the merits of the Belgian chemical school. He died in Ghent during the winter 1940—1941, from an infection of the lungs which, through the German occupation of Belgium, he had not been able to cure in a milder climate as he had formerly done each year.

Many facts made use of in this notice have been taken from the lecture that his friend, Professor Georges Chavanne of Brussels University, who also died during the war, presented in Ghent in 1936 at the meeting convened to do honour to Swarts on his retirement.

JEAN TIMMERMANS.