On Her Majesty's Service

Sir Robert Robertson

1869 - 1949

Obituary

CODE No. 27-31

both to its graduate and undergraduate life a more closely knit personal structure, which is much more difficult to achieve in " Red Brick " than in one of the older residential universities.

It was not an easy time for a Vice-Chancellor. First he had the war problems, and then the period of reconstruction. But under Miers' care the University gathered strength, and his Vice-Chancellorship was marked by many new developments. Under his sympathetic guidance the University took its full share in civic activities.

He was particularly happy once again to be Professor of Crystallography. He lectured regularly with his old skill, and whenever he could snatch an hour from official duties he was in the laboratory helping the students with that encouragement and personal interest that so many of them remember with affection. He was too busy to do any research himself, but he took the keenest interest in the work that was in progress, very happy that it was in his own field, the effect of environment on crystal growth.

His term of office would normally have ended in 1923, but the Senate pressed him to remain until 1926. When he left he must have been touched by the warmth and spontaneity of the many tributes from the University and the City for all that he had done for them.

In 1926 he returned to London and bought a house in Hampstead, meaning to return to his scientific work. But it was not to be. First there were jobs to be rounded off, and then, ever willing and eager to help in any constructive work, he was drawn into fresh activities.

In 1926 he undertook a Report on our Museums and Art Galleries for the Carnegie United Kingdom Trustees with S. F. Markham as his Secretary. As a result Museums became his chief occupation and interest for the rest of his active life. He served on the Royal Commission on Museums and on the Standing Committee appointed to carry on its work. He was President of the Museums Association for six years and with Markham he made a survey of the Museums in the Empire for the Carnegie Corporation. Miers was convinced of the great part Museums could be made to play in the life of the people if they were recast and for ten years he was the acknowledged centre of progress in all museum work.

As the years wore on, even his tireless energy began to flag, and when his eyesight failed and made travelling difficult the Museum work was left more and more to Markham. But he was never idle, and in these last years his happiness was the collection of plants in the London district and the care of his collection of photographs of classical sculpture. He never lost his enthusiasms and his interest in the doings of friends and pupils.

Miers's life was spent in the service of others. He was a fine teacher of the most generous type, clear and encouraging, and making everyone feel that there was a place for him in the world. Modest, unselfish, loving his fellow men, he was perhaps a little too gentle at moments in debate when a firm lead was needed. But he was a great humanist, and at times like these when the ethical influence of science is often called in question, Miers is an example of what a man of science can do in applying scientific methods in administration, and to the wider problems of academic and national life.

HAROLD HARTLEY.

SIR ROBERT ROBERTSON.

1869—1949.

THE death of Sir Robert Robertson at the age of eighty removes from our midst a man of outstanding personality. Primarily an expert of world-wide repute in the field of explosives, he had a great variety of other interests, mainly scientific, but including also such subjects as classics and historical research. He was a Fellow of the Chemical Society for over forty years and was twice a Vice-President.

Robert Robertson was born on April 17th, 1869, in Cupar Fife, and was the son of J. A. Robertson, D.D.S. Both the father and the grandfather had somewhat of a scientific bent. Robert was the eldest of a family of four; of his three sisters one, Jess Isabel, married William Rintoul, a colleague of Robertson's in his explosive work. Robertson was married in 1903 to Kathleen Stannus, daughter of Hugh Stannus, F.R.I.B.A., lecturer in Applied Art at South Kensington and Manchester. She inherited his artistic ability and has produced many charming works of art. She died in 1938. Two children, a daughter and a son, survive Sir Robert.

1876—1885.

At the age of seven Robertson entered the Madras Academy, Cupar Fife. The curriculum did not include science, but a small laboratory was fitted up at home. He showed great industry at school and gained many prizes. On leaving, he was awarded the Balgonie Gold Medal. In the Senior Local Examination of St. Andrews University he was placed first in Scotland and won the University prize.

1885—1890.

Robertson matriculated at St. Andrews University in October 1885 for the M.A. degree. In the 1885—1886 Session there were sixty "bejant" students, as they are called at St. Andrews in their first academic year. Two of these, Robert Robertson and Alexander MacKenzie, attained the distinction of the Fellowship of the Royal Society.

The course extended over four Sessions. No chemistry classes were included; it was, however, possible to take extra classes if time permitted and Robertson found that he could attend classes in science in his third and fourth years, which would enable him to qualify for the B.Sc. degree. A fellow student, David Lawson, who had attended Purdie's chemistry lectures, spoke enthusiastically to Robertson about them and he decided to enter for a chemistry class. In the following year he took a more advanced class and came for the first time under the stimulating influence of Purdie. This made a tremendous impression on him and ultimately a life-long friendship sprang up. Robertson took the M.A. degree in 1889, and in 1890, after a further summer course, he took his B.Sc. degree.

His affection for his old University was almost a passion. In his later life he was a founder member of the St. Andrews Club, London (1904), and was for many years Chairman of Council. He was always interested in historical studies and made a study of the Avignon Popes of whom the last, Peter de Luna (Benedict XIII), founded St. Andrews University in 1411.

1890—1892.

On leaving College, Robertson entered the laboratory of the City Analyst in Glasgow and worked under Robert T. Thomson (who recently completed his fiftieth year as a Fellow of the Chemical Society). Through him, Robertson made the acquaintance of James Miln Thomson, manager of the Cordite Section of the Royal Gunpowder Factory at Waltham Abbey, and this was destined to lead his steps into the explosives world.

1892—1907.

In 1892 Robertson was appointed as a junior chemist (at twenty-seven shillings a week) under J. M. Thomson. Thomson encouraged his young assistants to undertake investigations, to give them a greater interest in their work. He set Robertson to work on the relationship between the nitrogen content of nitrocellulose and its solubility in ether–alcohol. Robertson also made experiments on the preparation and properties of ethylene dinitrate, and on the basis of this work he obtained the D.Sc. degree of St. Andrews University in 1897.

A further practice, instituted by J. M. Thomson, was that his young chemists should spend six months learning factory operations side by side with the workmen; thus Robertson acquired a first-hand knowledge of the processes.

In 1894 there was a serious explosion in the nitroglycerine plant. With great pluck Robertson and two others "drowned" the remaining nitroglycerine in water and thus probably averted a further explosion. For this act he was presented with a gold watch by the Government. He regarded this watch as one of his most valued possessions. He was placed in charge of the nitroglycerine manufacture until 1900. During this time he and William Rintoul worked out a process for recovering acetone vapour, which had previously been allowed to go to waste in the cordite driers. This depended on absorption by sodium hydrogen sulphite and was applied on a very large scale.

In 1900 Robertson was put in charge of the Main Laboratory. He had a certain amount of time available for research and made a study of the Will stability test for nitrocellulose in its application to the purification of gun-cotton by boiling with water. He found that the best method of purification was to boil the gun-cotton initially with weak acid to hydrolyse unstable impurities; the acids could then be removed by prolonged boiling with water. This valuable discovery was published in 1906 and has become the standard practice in gun-cotton manufacture. He followed up this work by modifying the Will test to adapt it to the measurement of the rate of decomposition of nitroglycerine.

In a further research with S. S. Napper the absorption spectrum of nitrogen dioxide was examined and it was found that nitrogen dioxide could be detected and measured in low concentrations in air. This was utilised to measure the gradual decomposition of nitrocellulose at medium temperatures.

At about this time some of the cordite came under suspicion of having inflamed spontaneously. The Will test threw no light on this, and Robertson introduced a new stability test, the "Silvered Vessel Test." The cordite was ground and heated at 80° in a vacuum-jacketed and silvered flask. The decomposition was detected, first by visible fumes of nitrogen dioxide and then by a rise of temperature. The cordite then in use contained 5% of mineral jelly, and he found that if the mineral jelly were omitted or replaced by saturated hydrocarbons the stability was greatly decreased. From this it was deduced that mineral jelly contained a small proportion of hydrocarbons which reacted with nitrogen dioxide. Since nitrogen dioxide acts as an auto-catalyst in the decomposition its removal is beneficial to the stability.

A field of work which was the subject of considerable investigation by Robertson was the calorimetry of the explosion of cordite. This was based on the work of Sir Andrew Noble. The cordite was placed in a thick-walled steel bomb which was immersed in a calorimeter. The effect of mineral jelly and of the proportion of nitroglycerine was measured.

1906—1907.

In the summer of 1906 spontaneous explosions took place in two magazines in India. This required urgent investigation, and Colonel Nathan and Dr. Robertson were sent out to India to undertake this. The Silvered Vessel Test proved its value in correlating the decline of stability with the temperature and time of storage, and it was possible to lay down a safety limit, below which the test should not be allowed to fall. An exhaustive report was made on the conditions of storage with recommendations for the preservation of cordite in hot climates, and this remained for many years a classic source of reference.

1907—1914.

On his return from India early in 1907, Robertson was invited to take up the position of Superintending Chemist at the Woolwich Research Department. This Department had been in existence for about six years. It arose out of an experimental establishment set up by the Explosives Committee. The Committee included a number of illustrious scientists, among whom were Lord Rayleigh, Sir William Crookes, and Sir Andrew Noble. They took a personal interest in the work, which was very encouraging to the small staff of about half-a-dozen chemists. The original terms of reference were to improve the detonation of lyddite and to overcome the defects of the cordite at that time in use. The work, however, widened rapidly; many explosives were synthesised and examined, notably trinitrophenylmethylnitramine, for which a manufacturing process was worked out. Important work on the stability of propellants was carried out and the study of trinitrotoluene was commenced. New and well-equipped laboratories were built and the work expanded greatly. Unfortunately, the scientific Explosives Committee gave place in 1906 to a Board in which science had relatively little representation and in 1907 a military "Superintendent of Research" was appointed. Such was the background of the Department at the time of Robertson's appointment on April 7th, 1907. His University course for the M.A. degree had left him relatively little time to obtain a comprehensive knowledge of chemistry, but he brought a valuable fund of technical experience and a useful knowledge of safety precautions to the Department. His organising ability had full scope; he was a good administrator and had abundant energy; painstaking, methodical, and cautious in arriving at decisions, but obstinate in adhering to them in the face of any opposition. He was domineering and issued his instructions in the form of abrupt and peremptory orders. The junior members of the staff were terrified of him.

He realised the necessity of amassing a systematic fund of information on all subjects connected with explosives. This aided in dealing with the increasing influx of Service problems.

In view of its importance the stability of cordite was one of the most prominent subjects of investigation. The deterioration of cordite starts from minute nuclei of impurities and spreads by autocatalysis. An exhaustive study of the nature of the harmful impurities was made by means of climatic storage trials. This led to a better control of the cordite stored in magazines and to the introduction of precautions in the manufacture.

Work on high explosives was also in progress. A comprehensive study of the properties of trinitrotoluene was made and the manufacture and purification of trinitrophenylmethylnitramine were perfected. Important researches on the initiation of detonation of high explosives and the sensitiveness of explosives to impact were carried out. Robertson showed a keen interest in the progress of the work; he also fulfilled a useful function in establishing contacts with other Service departments. The opportunities for publication were very restricted on account of its secrecy.

1914—1918.

With the outbreak of war in August 1914 the Research Department was put to a strenuous test. With a staff of nine chemists and subordinate staff it was required to cope with a host of problems in a minimum of time. The work was so wide-spread that it cannot be dealt with in any detail. A few outstanding examples may, however, be mentioned.

In October 1914 improvement in the supply of trinitrotoluene (T.N.T.) became extremely urgent. Robertson was asked whether his Department could make three tons a week of T.N.T. to relieve the position. He immediately gave orders that work should be put in hand at the highest pressure to establish the most efficient method of manufacture. The existing processes were slow and inefficient. They also required oleum, which was not available. Intensive laboratory work was put in hand and a number of radical improvements were worked out. After a short time the work had reached a stage at which an experimental plant could be designed. Robertson's technical knowledge then stood him in good stead; he made a personal search of the scrap heaps of Woolwich Arsenal to find the necessary equipment and a plant for three tons a week was soon erected. This gave successful results and it was kept in production for a considerable time. In the early stages the supply position was so crucial that each week's output was seized upon with avidity for shell-filling, etc. This process was taken as the basis of the design of the large-scale Government plant at Oldbury and later that at Queensferry.

Although this work led to the expansion of T.N.T. production to a very large scale, it was still limited by the available toluene and it soon became evident that a still larger supply of high explosive would be required. In order to eke out the T.N.T. the use of a mixture of T.N.T. and ammonium nitrate was investigated at the Research Department. Trinitrotoluene is in itself deficient in oxygen whilst ammonium nitrate has a slight excess. A balanced mixture would be obtained by adding about four parts of ammonium nitrate to one part of T.N.T. At that time it was necessary to add about 40% of T.N.T. to enable the mixture to be melted to a slurry and poured into shells, but this was remedied later and made it possible to use the mixture containing 80% of nitrate. The detonation of this mixture was a difficult matter and numerous other difficulties arose such as hygroscopicity, corrosion of metals owing to hydrolytic dissociation, formation of dangerous salts with copper, etc., decomposition of T.N.T. by traces of pyridine and thiocyanate, transitions of crystalline form at $-16°$, $32°$, $85°$, and $125°$. The ammonium nitrate had to be made from Chile saltpetre by double decomposition and was difficult to purify. These difficulties were overcome step by step and this " dilution " of the T.N.T. enabled the quantity of available high explosive to be increased enormously. The mixed explosive was named " Amatol." (I have refrained from mentioning names of the staff working under Robertson, but think that the name of E. R. Deacon, who has since passed away, should be put on record for his valuable work on amatol.)

Another difficulty was that amatol gave little or no smoke on detonation and this made it difficult to locate the burst of the shell. To remedy this, smoke mixtures were devised and incorporated into the shell filling.

Meanwhile serious difficulties arose in the production of cordite owing to shortage of acetone. It was necessary to devise a propellant of the same ballistic properties as cordite M.D. without using acetone; it was also necessary that manufacture should be capable of being carried out in the existing plant. This was met by the introduction of a new propellant, " Cordite R.D.B.", in which the solvent used was a mixture of ether and alcohol. This propellant was ultimately manufactured in enormous quantities in the largest propellant factory at Gretna.

As the war proceeded, the difficulty of obtaining chemists for research work and for manning the factories became more and more acute. Scientists had been sent to the Front regardless of their value in producing vital supplies of munitions. It is amusing to read in a leaflet issued by the Parliamentary Recruiting Committee the advice given for Enlistment in Special Corps : " Men specially enlisted (a) such as Navvies, Tunnellers and Chemists."

In 1917 Robertson went to France and interviewed many scientists. This ultimately led to the return of valuable scientific workers to this country.

At the end of the war in 1918 the staff of scientists numbered one hundred and ten. When the news of the Armistice arrived, Robertson and a group of the staff were engaged in a conclave. It was typical of Robertson that he solemnly proceeded with the discussion and for another hour the scientists had to possess themselves in patience and continue the discussion.

During the war Robertson worked untiringly. He made a point of visiting the laboratories as often as possible to get first-hand information on the progress of the work. I think it may be said that this formed the peak of his long and active career. He was in the prime of life and rendered truly great services.

It was during the first World War that he was elected a Fellow of the Royal Society (1917). In 1918 he was created a K.B.E. in recognition of his valuable work.

1919—1921.

Much research work remained to be done after the war, but the staff dwindled rapidly after the Armistice. Robertson's time was very much occupied in the question of reorganisation of the conditions of employment of scientists. He continued to be a member of the Ordnance Committee and several other Committees until he left the Department on March 6th, 1921.

1921—1936.

On the retirement of Sir James Dobbie, F.R.S., from the post of Government Chemist, Sir Robert was appointed to this position and took up his duties on March 7th, 1921. In the Government Laboratory, which was already very efficiently organised, he was free to devote himself to work which was congenial to him. He took part in many committees and found time for private research.

The post of Government Chemist carries with it other duties, as he is Chief Agricultural Analyst, Referee under the Food and Drugs Act, and Advisor to the Board of Customs and Excise. The magnitude of the work of the Government Laboratory can be judged to some extent from the impressive Annual Reports. It increased largely during Sir Robert's tenure, owing to legislation such as the Safeguarding of Industries Act, etc.

Apart from the routine analytical work, special investigations were carried out at the Laboratory to assist Departments of State, *e.g.*, the carriage of dangerous goods at sea, the elimination of sulphur dioxide and nitrous gases in the atmosphere, the effect of lead tetraethyl in petrol on health, the investigation of the mineral resources of the Dead Sea for the recovery of potassium chloride, bromine, etc. Sir Robert served on numerous Committees dealing with these and other subjects.

Research on Infra-red Absorption Spectra.—Robertson's great wish was to devote himself to research. He told me that he felt he must do research " to save his soul." The work on infra-red spectra dealt with the three hydrides NH_3, PH_3, AsH_3. Robertson's interest in the subject arose out of the explosive nature of arsine gas, and the original object was to determine whether its decomposition would be accelerated by exciting the molecule with one of its vibrational frequencies. He was fortunate in having the collaboration of J. J. Fox, who had considerable experience in spectroscopy. The work was described in a series of papers in the *Proceedings of the Royal Society* by Robertson, Fox, and Hiscocks.

Special precautions were necessary to overcome the effects of electro-magnetic disturbances and mechanical vibrations caused by heavy road traffic. A tetrahedral structure was deduced for each of the three molecules, though not of equal height. The moments of inertia were calculated. In addition to the rotation system shown by PH_3 and AsH_3, NH_3 was found to have a further system of rotation. Beer's law was found to hold accurately. At that time there were very few infra-red spectrometers in the whole world. There is no doubt that the work of Robertson and his colleagues greatly stimulated infra-red spectrometric work in this country and abroad.

Research on Diamonds.—The published work on the infra-red spectrum of diamonds showed some discrepancies and Robertson proceeded to make a study of diamonds from different sources. In the examination of the first six diamonds one behaved abnormally. The other five gave a strong absorption band at 8 μ. but the sixth gave no such band. Later, other examples of this abnormality were found. Differences were also found in the ultra-violet. Other physical properties were examined; some of these properties showed differences between the normal diamonds (Type I) and the abnormal (Type II). In all, six abnormal diamonds were found, out of a total of three hundred examined. The joint work (Robertson and Martin) was summarised in the Jubilee Lecture to the Society of Chemical Industry (*Chem. and Ind.*, 1944, 18) in which the significance of the physical properties was discussed and surmises were made as to the conditions of formation of the two types in Nature.

Robertson took some interest in the question of the artificial production of diamonds and examined the minute specimens left by J. B. Hannay to the British Museum in 1880. At least one of these proved to be of the abnormal type.

1936—1939.

Robertson retired from the Government Laboratory on April 16th, 1936. He continued, however, to serve on several Committees. In 1937 he resumed experimental work at the Davy Faraday Laboratory. He designed and made apparatus for the exploration of spectra into the deep infra-red, *i.e.*, from 100 μ. downwards. In the middle of 1939 the war clouds became ominous and at the age of 70 he offered his services to his old Research Department at Woolwich.

1939—1945.

At the outbreak of the war, the work of the Research Department was decentralised. Robertson was placed in charge of the section which was stationed at University College, Swansea. The work was already well organised and Sir Robert was thus free to spend a large proportion of his time on Committee work under the Scientific Advisory Council, where his wide knowledge of explosives was of great assistance. In 1939 he was appointed Chairman of the Committee on Higher Explosives. From 1940 to 1942 he was Chairman of the S.A.C. Committee on Chemistry of Explosives and Physics of Explosives. He served also on a number of other Committees. The attendance at the meetings in London involved a great deal of travelling and included some hundred night journeys, an effort which would have taxed the strength of many a younger man. He was awarded the Davy Medal of the Royal Society in 1944 in recognition of his valuable services to Science and the Nation.

1945—1949.

At the end of the war Robertson had attained the age of 76, but was still full of vigour. He resumed his work at the Davy Faraday Laboratory, perfecting the technique of infra-red work and experimenting on the synthesis of diamonds. He extended Hannay's work and endeavoured to obtain crystalline carbon from solutions of cyanides in molten silver and other metals.

He was a member of the Armaments Research Advisory Board until his death. He was Chairman of the Committee which dealt with the Armstrong Memorial Fund (1945—1948). He continued as a Censor of the Royal Institute of Chemistry until 1946.

In 1947 he took an active part in the Centenary Celebrations of the Chemical Society. He was Chairman of an Exhibition at the Science Museum illustrating the achievements of British chemists during the last one hundred years and brought together a remarkable collection of apparatus of historical interest.

In 1948 he was appointed Editor in Chief of a comprehensive work on "The Science of Explosives," but after putting much work into this he was ultimately compelled by failing health to relinquish the Editorship.

He was practically free from illness until the early part of 1948, when he had a bad heart and congestion of the lungs. His tough constitution pulled him through, but he was much weakened. In 1949 he had influenza and broncho-pneumonia and passed away at his home in London on April 28th, just eleven days after his 80th birthday. He might almost be said to have died in harness, and I am sure he would not have wished it otherwise.

Thus ended a long and strenuous career. It was probably fortunate for him that he had to forge his way by hard work in his early years. From the beginning he strove after success and achieved it in a high degree. His honours included a presentation gold watch from the Secretary of State for War in recognition of gallant behaviour after a serious explosion in 1894, the Fellowship of the Royal Society in 1917, the K.B.E. in 1918, LL.D. St. Andrews in 1923, the Silver Jubilee Medal in 1935, the Coronation Medal in 1937 and the Davy Medal of the Royal Society in 1944.

In all that he undertook he worked tirelessly and conscientiously; his tenacity of purpose carried him through many difficulties. He was supremely self-confident, frequently autocratic and domineering. His tough constitution enabled him to retain his vigour into old age and his studious disposition remained with him to the end. He strove after recognition, but he had also his sentimental side; he was greatly attached to his old University and to his chemistry professor, and had many other intimate friends for whom he had a real affection.

International Relationships in Chemistry.—An account of Robertson's activities would be incomplete without some reference to his efforts to further co-operation and friendly intercourse with scientists abroad. As President of the Chemical Section of the British Association at Toronto in 1924 he made many lasting friendships. Whilst on the American continent he travelled to Vancouver and back, and then to the United States, where he established profitable relations with our fellow-scientists. In 1927 he visited Paris as Royal Society representative at the Berthelot Celebrations and made a further visit in 1931. In 1930, and again in 1934, he visited Belgium and Northern France in connection with the problem of water-pollution. In 1934 he attended the International Congress of Chemistry at Madrid and in 1936 he visited Roumania, Istanbul, and Austria. In 1937 he went again to Paris for the Congress of Industrial Chemistry, and in 1938 he took part in the International Congress of Chemistry at Rome. He readily got on to a friendly footing with scientists abroad and in return he welcomed them on their visits to this country and showed them hospitality at his home. In so doing he rendered a real service to Science. With him national boundaries formed no barrier to the establishment of fraternal relations. During the war of 1939—1945 he was in very frequent contact with the Canadian and American representatives and did much to promote their co-operation.

In this connection the "Catalysts' Club" should be mentioned. It was established about thirty years ago, and one of its purposes was to entertain distinguished foreign visitors to this country having similar interests to those of the Club. Robertson took an active part in this and often presided at the meetings. The Club was well named and Robertson was distinctly a good catalyst. He was good company and, as one member put it, they liked his pawky humour.

Societies and Institutions.—Robertson's loyal devotion to the learned Societies was a feature which greatly impressed his colleagues and friends and he attended, and often presided at, a great number of scientific meetings.

Royal Society. Robertson was elected a Fellow in 1917. He served on a number of Committees, including the Committee on Applied Sciences (1919—1922) and the Committee for exhibit on Pure Sciences at the British Empire Exhibition (1922). He represented the Royal Society on the General Board and Executive Council of the N.P.L. (1925) and in the Berthelot Celebrations at Paris (1927). He was awarded the Davy Medal in 1944.

Chemical Society. He was elected as a Fellow in 1907 and was a Member of Council 1919—1922. He was a Vice-President in 1926—1929 and again in 1936—1939. In 1922 he represented the Chemical Society on the Conjoint Board of Scientific Societies. His activities in connection with the Centenary Celebrations are mentioned above.

Faraday Society. Elected 1920, he became a Member of Council in 1921 and was President in 1922—1924.

Royal Institution. Robertson was a devoted member of this Institution. He was elected in 1921, became Manager in 1924, Secretary 1926—1929 and Treasurer 1929—1946. During this time he acted as Vice-Chairman. When the renovation of the theatre and various building became urgent he took an active part in obtaining the necessary funds (about £100,000). During the Faraday Centenary Celebrations in 1931 he frequently presided at meetings.

British Association. Robertson was President of Section B (Chemistry) at the Toronto meeting of 1924.

Royal Institute of Chemistry. He became a Fellow in 1897, Member of Council 1915—1918 and 1921—1932, Vice-President 1918—1921.

Salters' Institute. Robertson was appointed Director in 1937 and continued to hold this post until shortly before his death.

London University. Member of Board of Studies for Chemistry and Chemical Industry 1921—1925 and 1944. Board of Advisors in Chemistry.

Ramsay Fellowships. Member of Advisory Committee 1921.

Ramsay Chemical Engineering Department. Member of Committee.

He was also a member of a number of other Scientific Societies and of the Royal Society Club and the Athenæum. His activities in connection with the St. Andrews University Club, London, have already been mentioned.

He maintained a close connection with the Scottish Universities through his position as Advisor in Physical Chemistry under the Carnegie Trust.

R. C. FARMER.

F. E. WHITMORE.

1923—1949.

FRANK EDWARD WHITMORE lost his life on July 25th, 1949, at the age of 26 in a climbing accident in Switzerland and his death came as a severe shock to his former teachers and to his colleagues and many friends in Birmingham.