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SIR JAMES IRVINE, K.B.E., F.R.S.

1877-1952

James Colquhoun Irvine, honorary member and Willard Gibbs medallist of the American Chemical Society, was born in Glasgow, Scotland, on May 9, 1877, and received his early education at Allan Glen's School. After a period at the Royal Technical College, Glasgow, he became a student of the University of St. Andrews in 1895, and from that date it may be said that his whole life was dedicated to the well-being and advancement of the University, of which he became in due course one of the most illustrious Principals and Vice-Chancellors in its long history of five and a half centuries. Of few indeed can it be recorded that without a break they served their University brilliantly as student, lecturer, professor and principal.

When Irvine entered St. Andrews the head of the Chemistry Department was Thomas Purdie who was quick to appreciate the outstanding qualities of his new pupil. Purdie himself was one of the great figures in chemistry in the late 19th century and for him as teacher, investigator and friend Irvine retained a life-long regard and veneration. A brilliant undergraduate career ended with the award of the B.Sc. degree in 1898. There followed a period of study for the Doctor's degree at Leipzig in Wislicenus' laboratory and it was during his stay in Germany that Irvine conceived the idea of using Purdie's method of methylation as a means for the investigation of molecular structure in the carbohydrate group. He realised the full significance of the new approach, which has indeed proved so fruitful and powerful that its usefulness is by no means exhausted after half a century's intensive application by chemical schools in all parts of the world. He returned to St. Andrews to develop the new ideas and when Purdie retired from the Chair of Chemistry in 1909 Irvine was

chosen as his successor, holding the post until 1921 when he was appointed Principal of the University. For five years after succeeding Purdie, during which took place the celebration of the 500th anniversary of the founding of the University of St. Andrews, Irvine rapidly pushed forward his work on carbohydrates but on the outbreak of the first world war in 1914, academic work was interrupted and the laboratories were hastily re-organized for the preparation of fine chemicals urgently required by the British and allied governments. These materials included in the first instance carbohydrates such as dulcitol, fructose, mannitol and inulin. Then came the demand for the preparation in quantity of orthoform and novocaine, followed by intensive and dangerous work on the synthesis of mustard gas in which Irvine played a notable part. How all this was accomplished, largely by voluntary workers possessing little or no chemical training, is a story in itself. It was a triumph of organisation on the part of Irvine and W. N. Haworth, who was then Reader in Chemistry in the University. Fundamental research work was resumed in 1919 and despite difficulties of accommodation in the grossly overcrowded laboratories a large and enthusiastic group of research workers quickly assembled for a systematic study of the sugar group. At this stage Irvine was at the height of his powers as a teacher and as an organiser and director of research. He was an inspiring lecturer and his lectures, given with a wealth of experimental illustration, were models of clear exposition. More than that, they inspired in his students a love of chemistry and gave them a desire to take part in the discoveries that Irvine himself was then initiating. His informal talks to research workers on new developments and the discussions in the laboratory

with those whose work he was supervising were equally stimulating.

It was inevitable that less of his time could be given to chemistry when he took over the responsibilities of the principalship. Nevertheless, Irvine never ceased to take a major interest in research. In illustration of this it may be mentioned that the writer of this notice has in his possession a letter from Irvine, written only a few days before his death, in which he propounded a comprehensive scheme of research on possible developments of sugar derivatives for chemotherapeutic purposes. The pioneer work of the St. Andrews laboratories had aroused a new interest in the structural chemistry of the sugars and had, in fact, opened a new era in this branch of study. An ever increasing volume of important work inspired by it was carried out subsequently in many different laboratories in all parts of the world. Notable amongst these was the Chemistry Department of the University of Birmingham under the direction of Sir Norman Haworth whose first interest in this field had been acquired during the tenure of an appointment in St. Andrews.

In Irvine's early days the University of St. Andrews, old in years and proud of its time-honoured tradition for sound learning, was suffering from a lack of suitable buildings and equipment for the pursuit of scientific enquiry. The number of students was small and the financial position was difficult. Yet Irvine had faith, to use his own words, "unconquered and unconquerable in the beloved University of St. Andrews," and in the course of his 31 years as Principal it is no exaggeration to say that he changed the face of the University. As it is seen today it stands as a monument to the inestimable services of this distinguished Principal. He had already shown high administrative ability while Professor and Dean of the Faculty of Science. His success in the onerous tasks which came to him as Principal and Vice-Chancellor revealed these powers to the full. He possessed both the vision of the seer and the drive and practical sense of the man of affairs, a rare combination which enabled him to guide the University in such a way that essential modern developments could be incorporated in the picturesque traditions and pageantry of an ancient foundation. One of his main concerns was the revival of the residential system and the institution of Regents responsible for guiding and advising small groups of undergraduates. St. Salvator's Hall for men students with its entrance scholarships, rendered possible by the generous Harkness benefactions, is an outstanding example amongst many Halls of Residence provided both for men and for women students during the past 30 years. The latest, completed shortly before his death, was a small but very beautiful residence for use by post-graduate research workers.

Irvine's period of office was marked by developments in all faculties, and new buildings to accommodate the increased number of students were constructed both in St. Andrews and in Dundee where rapid advances were taking place, particularly in connection with the schools of medicine

and engineering. Fundamental changes of this kind had impacts in both divisions of the University and inevitably led to differences in outlook and to difficulties which, to Irvine's great grief, had not been fully resolved by the spring of 1952. Nevertheless he remained hopeful and to the end retained his faith that the University could and would overcome all such obstacles no matter how formidable.

So great were Irvine's services to his University that it is impossible to convey any adequate idea of them in a brief notice. Yet as the years passed by he found himself called upon to play a prominent part in yet wider activities. He gave much thought and time to the preservation of the historical buildings and character of the city of St. Andrews. He was a member of innumerable boards and committees. Amongst these may be mentioned the Scottish Universities Entrance Board of which he was Chairman for many years. He took great interest in the work of the Forest Products Research Board of the Department of Scientific and Industrial Research and guided its activities as Chairman for 12 years (1927-1939). He was chairman also of the Advisory Council of the Scottish Education Department (1925-31), of the Inter-University Council for Higher Education in the Colonies (1946), of the Viceroy's Committee on the Indian Institute of Science (1936), and of the Adult Education Committee for Scotland (1927-29). He served as a Commissioner for the 1851 Exhibition funds, and as a member of the Prime Minister's Committee on the Training of Biologists (1931). He played a prominent part in the foundation of the University College of the West Indies, being Chairman of the Committee on Higher Education in the West Indies (1944). This work in which he was deeply interested, involved arduous and dangerous journeys and it was a source of great satisfaction to him to be present at the inauguration of the College and to realise that in many respects, including the adoption of the Red Gown by its students, it had been founded on the traditions of his own University in Scotland. He had a warm regard and respect for the United States and took special pride in his work for the Pilgrim Trust, of which he was a Trustee, and for the Commonwealth Fellowships Fund. He made several visits to America where he made many friends, and amongst his many activities in the United States mention may be made of his visits to Williamstown as Foreign Lecturer at the Institute of Politics (1926); to Princeton University as Vanuxem Lecturer in 1929 and to Yale University as Woodward Lecturer in 1931. This wide range of interests shows clearly that whilst in his early years Sir James Irvine's main task lay in promoting the growth of scientific studies at St. Andrews his outlook was by no means bounded by it. He was indeed deeply sensible to the traditions and aspirations of the University as a whole. He himself possessed in full measure a love of humanistic studies which was reflected in his writing and in the magnetic appeal of his oratory. His character and personality displayed a similar versatility. He had a remarkable power of reduc-

ing a complicated problem to its essentials, yet he could retain in his memory the minutest details. He was persuasive in argument, yet forceful and determined in carrying through cherished projects once his mind was made up and the decision had been taken. He was genial and charming in his human relationships and one to whom his students instinctively turned as a trusted friend. He took unaffected delight in the honours which came to his friends, and his forward-looking mind showed a discerning sympathy with youthful hopes and aspirations. He could always find time, no matter how pressing the business of the day might be, to write by hand letters of kindly encouragement and congratulation to his youthful colleagues and acquaintances.

Throughout his career he owed much to the never failing devotion and counsel of his wife Mabel Violet, younger daughter of John Williams of Dunmurry, County Antrim, whom he married in 1905. Sir James and Lady Irvine had three children, two daughters and one son. The death of their son Nigel on active service during the second world war was a blow from which Irvine found it hard to recover. Throughout his life he had spent his energies freely and although he faced the many difficult problems of the post-war years with all the old-time fire and zest the strain was beginning to tell. It was his great desire to pilot the University through the period of reconstruction which had to be faced but this wish remained unfulfilled. He had a very serious illness in the early summer of 1951 and although he made a remarkable recovery he was never again able to undertake in full his multifarious duties. Yet the old spirit prevailed and he insisted on doing more than his strength was able to bear. Shortly before his death he had visited London for a meeting of the Pilgrim Trust and only two days before the end, which came without warning on June 12th, 1952, he had presided over a long and important meeting of the University Court at St. Andrews. Two years earlier in connection with the quincentenary of the founding of St. Salvator's College, Irvine had written these words: "I find myself a twentieth century scientist gazing across the chasm of five hundred years to a strange remote world and am conscious afresh of a feeling which never entirely escapes me that, as the thirty-fourth Principal of St. Salvator's College, I am privileged to share in the inheritance of a solemn trust." It is beyond all shadow of doubt that by his contributions to learning both as teacher and as investigator, by his devotion to College and University and in the wisdom he showed in many-sided activities in the widest fields of scholarship and statesmanship, he had nobly and faithfully discharged the duty committed to that long succession of Masters of the College.

Irvine was the recipient of many honours, the award of which gave him much satisfaction although he was far from seeking any such rewards for himself. His scientific work brought him the Fellowship of the Royal Society in 1919 and he was awarded the Davy Medal of the Royal Society in 1925; he was President of the Chemistry Section

of the British Association for the Advancement of Science in 1922; Longstaff Medallist of the Chemical Society (London) (1933) and Member of Council (1918-1922); Willard Gibbs Medallist of the American Chemical Society (1926); Medallist of the Franklin Institute. He was a Fellow of the Royal Society of Edinburgh (1917), of which he was Vice-President (1922-25) and he received the Gunning Victoria Jubilee Prize, one of its highest honours, in 1940. He was an honorary member of the American Chemical Society, the American Philosophical Society and the Franklin Institute. His academic honours included the degrees of Ph.D. (Leipzig), D.Sc. (St. Andrews); Hon. D.Sc. (Liverpool, Princeton, and McGill); Hon. Sc.D. (Cambridge, Pennsylvania and Yale); Hon. D.C.L. (Oxford and Durham); Hon. LL.D. (Glasgow, Aberdeen, Edinburgh, Wales, Toronto, Columbia and New York). He was a Freeman of the City of St. Andrews, and a Justice of the Peace. He received the C.B.E. in 1920, a Knighthood in 1925 and in 1948 he was awarded the high honour of K.B.E.

Irvine's scientific work was that of a pioneer in new fields. He quickly realised the potentialities of Purdie's methylation technique as a weapon for structural investigations and in a letter to Purdie written from Wislicenus' laboratory at Leipzig he outlined the whole field of its application in the carbohydrate group. At that time little was known with certainty of the fine structure of the sugars and until some method could be found for rendering less active the free hydroxyl groups of the simple and complex sugars progress appeared to be impossible. Irvine saw that the transformation of the hydroxyl groups into their methyl ethers by Purdie's reaction with silver oxide and methyl iodide provided exactly what was needed for the next great advance in carbohydrate chemistry. He indicated how the method could be used to determine the position of linkage in disaccharides and higher sugars and on returning to St. Andrews he proceeded to a systematic study of the methylated sugars. A report on the alkylation of sugars was given to the British Association in 1902 and a note on the application of the method to disaccharides was given at the subsequent meeting of the Association in 1903. It was necessary to provide standard reference substances for this work and investigators in the St. Andrews laboratories began a detailed study of the preparation and properties of the methylated derivatives of the simple sugars. Amongst these may be mentioned tetramethylglucose and its α - and β -methylglucosides and corresponding derivatives of galactose and mannose. Attention was given also to derivatives of the methylated sugars such as oximes, anilides and hydrazones. He showed also that a non-reducing octamethyl disaccharide of the trehalose type could be prepared by the condensation of two molecules of tetramethylglucose under the influence of an acid catalyst. In these early days the Purdie reaction provided such a rich field for exploration that alongside the carbohydrate work Irvine and his associates devoted attention also to other types of hydroxy bodies. The constitution of the glucoside

salicin was determined by the methylation method and several papers appeared on the chemistry of benzoin and benzoin-like materials and as early as 1907 we find Irvine collaborating with the Botanical department at St. Andrews in a study of the properties of humic acid. There were several papers also on the isopropylidene and methyl derivatives of glycerol and mannitol.

The next stage in the development of the carbohydrate work involved the preparation of the partially methylated sugar derivatives. These were obtained in various ways and led amongst other developments to studies of the constitution of the acetone derivatives of glucose, fructose and mannose. Much was learned in this difficult field but in many cases exact structural formulae could not be applied until the nature of the ring systems present respectively in the stable and the labile forms of the sugars became known many years later.

From the beginning of Irvine's work on carbohydrates it had been realised that the ultimate goal was an exploration of the wider fields of oligosaccharides and polysaccharides from the point of view of molecular structure. Preliminary work on the methylation of cellulose by Denham in the St. Andrews laboratories by the methyl sulphate method led to the isolation of the important reference substance 2:3:6-trimethylglucose. At this time W. N. Haworth, then a member of staff at St. Andrews, began to take an enthusiastic interest in carbohydrate chemistry, developing the methyl sulphate method of methylation and applying it to sucrose, cellobiose, lactose, maltose and raffinose. Irvine now turned more towards the polysaccharides and began a series of studies on the methylation of inulin and the methylated fructoses obtained from trimethyl inulin on hydrolysis. Investigations into the structure of cellulose were also undertaken and brief reference may be made to the quantitative degradation of cellulose to methylglucoside via cellulose acetate, the preparation of trimethylcellulose and the proof, from examination of its products of hydrolysis, that methylated cellulose was composed almost entirely, certainly

to the extent of more than 90 per cent, of 2:3:6-trimethylglucose residues. Pioneering work was carried out also in the St. Andrews laboratories on the methylation of starch and allied substances.

Another example of the insight which led Irvine to discern problems of special importance is found in his study of natural chitosamine (glucosamine). He showed that this substance could be transformed, by appropriate procedure, into a derivative of either glucose or mannose, but here again the final resolution of the problem came only many years later when proof of the glucose configuration in glucosamine was obtained by entirely novel methods.

He examined with great thoroughness the coupling of glucose with derivatives of " γ " fructose in order to find out whether a synthesis of sucrose could be effected by such processes. An isomeride of sucrose was obtained and its properties were examined but on no occasion could any trace of sucrose itself be detected—a result which has received ample confirmation at the hands of many subsequent investigators. In later years much important work was carried out at St. Andrews on anhydro-sugars and their methylated derivatives (G. J. Robertson) and on the nitrate esters of methylated sugars (J. W. Oldham). The last scientific paper which carried Irvine's name was one with Robertson published in 1938 on the subject of interconversion of the simple sugars.

Irvine's scientific work cannot readily be summarised. His interests ranged widely and his papers deal with many diverse aspects of carbohydrate chemistry. They are characterised by the clarity of thought and elegance of style which are found in all his writings and were immediately evident also in his lectures and speeches. The ideas which he promulgated have proved singularly fruitful and the pioneering exploits of the small band of research workers in St. Andrews nearly half a century ago have instigated chemists in many lands to the endeavours which have resulted in the imposing edifice of carbohydrate chemistry as it stands today.

E. L. HIRST