



Leslie Hough

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Leslie Hough, always Les to his numerous friends, was born in Salford, Lancashire on March 26th, 1925. After a war-time education, fragmented by evacuation during the period of intensive bombing of the Manchester area, he left school at the age of 17. He joined a pharmaceutical company as a student chemist, and after two years of intensive evening and part-time study, he had achieved the necessary qualifications to enter Victoria University of Manchester in 1944, from which he graduated in 1946. By this time, Professor E. L. (later Sir Edmund) Hirst and Dr. (later Professor) J. K. N. Jones had joined the Department of Chemistry at Manchester and were responsible for the stimulation of Les' interest in carbohydrate chemistry, which was the start of a lifelong career in which he was to distinguish himself.

He commenced his graduate studies in 1946, initially working with J. K. N. Jones on the structure of starch, for which he was awarded an M.Sc. in 1947. He then continued with structural studies of an intractable and obscure gum from an African plant *Stericula setigera*, which, with the timely discovery of paper chromatography, yielded numerous results and several papers as well as a Ph.D. in 1949. The one thing that has characterised Les Hough throughout his career has been his relaxed approach to life in general, so that at Manchester he was able to carry out some outstanding research work whilst maintaining a very full social and sporting life. He played rugby football for the University and courted his girlfriend Irene, who was to become Mrs. Hough in 1947, two years before he was awarded his Ph.D.

"Eddie" Hirst then accepted the Chair at Edinburgh and Ken Jones decided to return south to the University of Bristol, taking Les with him, to found a new degree course in Biological Chemistry. At Bristol, they entered a happy and rewarding research collaboration, with Les accepting a lectureship at the University in 1950. Les often recalls how Ken Jones' abundant enthusiasm and perception often led to half a dozen or more problems proceeding simultaneously on Les' rather small but well organised bench. The application of cellulose column chromatography had revitalised the carbohydrate area and had opened up new and important domains for investigation. Progress on the analysis of sugars and the structural investigation of polysaccharides was usually so rapid that papers were drafted almost daily over coffee at the Cadena Cafe, just across the road from the University. In those long gone, but infinitely more civilised days, morning coffee was served to the accompaniment of a string trio, which Les insists was a great source of inspiration in the writing of his early papers. Much of the early work on chromatography at Bristol was a milestone in the application of chromatography to carbohydrate chemistry, and Les was particularly proud of one paper [*"Quantitative analysis of mixtures of sugars by the method of partition chromatography. Part V. Improved methods for the separation and detection of sugars and their methylated derivatives on the paper chromatogram"*], L. Hough, J. K. N. Jones, and W. H. Wadman,

J. Chem. Soc., (1950) 1702], which proved to be one of the most highly cited chemistry papers.

His early work on the structural studies of polysaccharides soon broadened into a study of the biosynthesis of monosaccharides, particularly those of plum trees. The realisation that monosaccharides were synthesised by an enzymic aldol reaction resulted in a series of nine papers on the aldolase reaction, in which its specificity for the *D-threo* configuration was exploited; this must be one of the first successful attempts to control the stereochemistry of the aldol reaction, a matter of great contemporary concern.

He took sabbatical leave from the University of Bristol for the year 1952–1953, to study as a Fulbright Scholar with Professor Roy L. Whistler at Purdue University. An early success with a dehydrogenase-based method for the assay of glucose in corn syrups was rewarded by an invitation to the 1952 Starch Round Table at the Skytop Club, Pennsylvania, where he met the legendary Claude Hudson and many other outstanding carbohydrate chemists and biochemists — which Les recalls as an inspiring occasion for a young and unknown chemist. At Purdue, he became an avid fan of American Football, and was recently enthused by the appearance of the sport on British T.V. During this period, he formed long-standing friendships with Roy Whistler, John Hickson, Jack Hylin, and Ed. Conrad.

Les returned to Bristol in September 1953 to find that Ken Jones had accepted the Chown Research Chair at Queen's University, Kingston, Ontario, leaving Les to take responsibility for carbohydrate research in Bristol, which he did with great distinction until his own departure in 1967. For a number of years afterwards, there was a steady flow of research students and post-doctoral fellows from Bristol to Kingston, including Malcolm Perry, Phil Gorin, Derek Ball, and Terry Painter.

At Bristol, Les' research turned slowly away from polysaccharides and biosynthesis. Although he kept one foot in the door for many years, and until quite recently always had at least one research worker on glycopeptides, he slowly developed interests in the chemical reactions of mono- and di-saccharides. This was initially motivated by a need to understand the action and selectivity of reactions that he had used in the polysaccharide and biosynthesis work, such as borohydride reduction, periodate oxidation, and the degradation of aldohexoses into aldopentoses by the disulphone method, developed earlier by H. O. L. Fischer.

At Bristol, many of his research students came to him from the ranks of the Bristol graduates who had previously carried out a final year research project under his supervision. In those days, the choice of project students was carried out one student at a time in order of staff seniority, so that the brightest and best always went to the more senior professors, and supposedly the worst to the more junior lecturers such as Les. However, when it came to Les' choice, he ignored the performance in chemistry and always selected those students who had performed best at mathematics, arguing that any student able to cope with the universally unpopular mathematics course was likely to be good at chemistry. This unorthodox approach yielded spectacular results, with Les' students always getting excellent results, enabling them to secure a grant to pursue a

Ph.D. course. In this way, Les had a succession of bright, innovative, strongly motivated research students, including myself, Laurie Hall (Professor of Medical Chemistry, University of Cambridge), Don Anderson (Professor of Medicine, University of British Columbia), John Clamp (Professor of Medicine, Bristol University), Bruce Coxon (National Bureau of Standards, Washington), Riaz Khan (Tate & Lyle Plc.), and many others.

Life in Les' laboratory at Bristol in those days was the perfect balance between intellectual activity, practical accomplishment, and social pleasure. Although the lights in the laboratory often burned long into the night, Les always insisted that there be regular social activities and contact between himself and his students. This included, amongst other things, tennis and squash, which Les played with great vigour if not some skill. However, no matter how good a player the student, the unwritten rule was to give Les a hard game and even take him to the brink of defeat, but never to beat him until the Ph.D. had been awarded! Most of Les' research students will recall with nostalgia the regular research meetings in the early evenings, which were often concluded by visits to local hostleries, sometimes with skittles and darts, and finished off late in the evening with traditional fish and chips (in newspaper of course).

In 1967, Les was appointed as Professor and Head of Chemistry at Queen Elizabeth College, which was one of the constituent Colleges of the University of London. Here he established, in collaboration with myself, a fertile environment for carbohydrate research conducted by a stream of gifted graduate students from all over the globe. From 1980, he was Vice-Principal of the College until its merger in 1985 with King's and Chelsea Colleges, when he was elected to the distinction of Fellow of the College for his meritorious endeavours in the difficult process of amalgamating three disparate institutions. The admiration and esteem in which he is held by the scientific community was recognised by the award of the Haworth Medal and Lectureship by the Royal Society of Chemistry in 1985, the Hudson Award in Carbohydrate Chemistry by the American Chemical Society in 1988, and the Science Award of Sugar Processing Research Inc., also in 1988.

During a research career that spans some 40 years, Les has made very substantial and lasting contributions to the science of carbohydrate chemistry, emanating in almost 300 publications. These studies have embraced a large number of organic structural types, from trioses to polysaccharides. Many novel sugar derivatives have been prepared and studied, including amino sugars, disulphones, epoxides, aziridines, glycopeptides, nucleosides, halogenated sugars, acetals, carbohydrate-derived alkaloids, and nitro sugars. He also carried out several important studies of mechanistic investigations, including reduction of aldoses by sodium borohydride, oxidation of aldoses with sodium metaperiodate, nucleophilic degradation of diethylsulfonylpyranosylmethane derivatives, the epimerisation of aldoses and acetamido sugars, and the nucleophilic replacement reactions of carbohydrate sulphonates, and, in the early 1960s, he was at the forefront of the application of n.m.r. spectroscopy to carbohydrates.

A significant move into the area of "sucrochemistry" was made in the late 1950s as a result of the grants made available from the International Sugar Research Founda-

tion, and later extended to include most of the other readily available oligosaccharides (lactose, maltose, trehalose, and raffinose). This enormous research effort has resulted in almost a hundred publications and the discovery of the intense sweetness of certain chloro-sucroses. Sucralose, 4-chloro-4-deoxy- α -D-galactopyranosyl 1,6-dichloro-1,6-dideoxy- β -D-fructofuranoside, was a product of this work and is currently under evaluation as a high-intensity non-calorific sweetener; it was made by Les Hough and his co-workers in the mid 1970s and is likely to be launched onto the market in the early 1990s.

The high affection and esteem in which Les Hough is held by people who have worked with him is in part due to his extreme generosity of spirit, to his constant willingness to accept new ideas and undertake new research directions, to his gracious encouragement of co-workers through difficult endeavours, both scientific and personal, and to many other admirable qualities.

Les has always been closely involved in professional affairs, to which he was usually able to add a touch of flamboyance. A classic example was in his term of office as the founding Chairman of the Carbohydrate Discussion Group of the Chemical Society, in which at least one committee meeting is reported in the minutes as being held at The Playboy Club in Mayfair! He has also been Secretary and Vice-President of the Perkin Division of the Royal Society of Chemistry, and served on the organising committees of the 1978 London Symposium on Carbohydrate Chemistry and the 1991 European Carbohydrate Symposium in Edinburgh. He was the British representative on the Steering Committee for International Carbohydrate Symposia for many years.

As head of the Chemistry Department at Queen Elizabeth College, he was always the perfect diplomat and strategist. He always instinctively knew when to give ground and when to give a gentle heave; he always came away with exactly what he wanted and managed to retain his popularity throughout. It was under his guidance that the Department gained considerable national and international recognition.

In 1987, Les and Irene celebrated their Ruby wedding. They have two sons, Courtney and Peter, and four grandchildren. They have lived in Wimbledon close to the All England Tennis Club for about 20 years. They are both still keen on tennis, but Les has bowed to the inevitable and given up squash. He and Irene are very accomplished bridge players and they spend much of their leisure time either at this pastime, on the tennis courts, or on the golf course.

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