

PROFESSOR JOHN GRANT BUCHANAN

This issue of *Carbohydrate Research* is dedicated to Professor John Grant Buchanan, in recognition of his outstanding contributions to a range of areas in carbohydrate chemistry and biochemistry, and on the occasions of his 65th birthday and his retirement from the Chair of Organic Chemistry at Heriot-Watt University.

Grant Buchanan – always known to family and friends by his second Christian name – was born, as the elder of two brothers, on September 26th, 1926 in Dumbarton, a town on the northern shore of the Firth of Clyde some 20 km west of Glasgow, and in an area of Scotland closely linked historically with the name Buchanan. After initial schooling locally, Grant Buchanan's secondary education was at Glasgow Academy, where he gained a typically wide range of Scottish 'Highers', but with an emphasis on Science subjects. The Buchanan family business was concerned with running a glue works, but this was one area of natural products chemistry which did not seem to appeal to Grant. Thus, in 1944, he took the long road south to study Natural Sciences at the University of Cambridge, assisted by a Scholarship from Glasgow Academy.

The beginning of Grant Buchanan's undergraduate studies coincided fortuitously with the arrival in Cambridge of his fellow Scotsman Professor Alexander Todd (later Lord Todd, and Nobel Laureate of 1957). Indeed, the young Buchanan became a junior member of the same College, Christ's, at which Todd was elected to a Professorial Fellowship, and of which he was in later life to serve as a distinguished Master. During his undergraduate years, Grant Buchanan became particularly interested in the interplay of chemistry and the life sciences, and it is therefore hardly surprising that after graduation he was enticed by the prospect of doing research in the exciting intellectual atmosphere of Todd's group.

One can, however, feel a fair degree of sympathy towards a new research student who is asked, in 1948, to work on the structure of Vitamin B₁₂, which at that time had just become available in strictly limited quantities of somewhat dubious purity. For this was indeed the research topic to which Grant Buchanan was invited to address himself under the direction of Todd, ably assisted by the late Alan Johnson (subsequently Professor of Organic Chemistry at the University of Sussex), and by Cedric Hassall (later Professor at University College, Swansea, and Director of Research at Roche Products Ltd.). Nonetheless, Grant's studies established the correct location of the phosphate unit on either the 2'- or 3'-hydroxyl group of the α -D-ribofuranosyl-dimethylbenzimidazole ligand of the vitamin, and for this work he was awarded his Ph.D. in 1951. This initial grounding in the chemistry of nucleotides and sugar phosphates was to prove highly significant in Grant's later career.

From Cambridge, Grant Buchanan moved to a postdoctoral fellowship in the laboratory of another future Nobel Laureate, Melvin Calvin, in Berkeley, California.

Grant's work there was concerned with establishing the involvement of uridine diphosphate glucose (UDPG), one of the nucleoside diphosphate sugars then only recently identified by Leloir, in the biosynthesis of sucrose, and also with the intermediacy of a sucrose phosphate in this process. It was shown that, in this sucrose phosphate, the phosphate group was attached to the D-fructose residue, although the precise location could not be confirmed. This material is now well established as sucrose 6'-phosphate, and many years later Grant Buchanan was responsible for the first unequivocal synthesis of this compound.

Although Grant may well have wished to spend longer in Berkeley, this was the time of the Korean War, and a prolonged stay in the U.S. might have resulted in Grant's making an involuntary trip across the Pacific in the service of Uncle Sam. Thus, after just one year, he returned to Britain to take up a post at the Lister Institute for Preventive Medicine in London, working with Dr. James Baddiley (later Professor Sir James Baddiley). In 1955, Baddiley was appointed to the Chair of Organic Chemistry at King's College, Newcastle, an institution that was at the time a College of the University of Durham, but which was in due course to metamorphose into the independent University of Newcastle-upon-Tyne. Grant Buchanan moved to Newcastle with Baddiley, but not before he had met his future wife Sheila; they were married shortly after Grant's move north, and have three sons. After a short time in Newcastle, Grant was appointed to the post of Lecturer there.

Grant Buchanan's time at the Lister Institute and in Newcastle was to prove one of great scientific productivity. Although his original brief with Baddiley was to work on the synthesis of Coenzyme A, Grant soon became involved in another project in Baddiley's laboratory concerned with the characterisation and synthesis of two nucleotide derivatives, cytidine diphosphate glycerol and cytidine diphosphate ribitol, from *Lactobacillus arabinosus*. Although, at the time they were first identified, the biological role of these compounds was unclear, it soon became apparent that they were biosynthetic precursors of a novel type of cell wall polymer. In a series of definitive papers in the late fifties and early sixties, Baddiley and Buchanan established the major structural features of these macromolecules, for which in their first publication they coined the name 'teichoic acids', in a range of Gram-positive bacteria. Alongside this work on teichoic acids and their constituents, Baddiley and Buchanan also collaborated on chemical studies of the pathway for the biosynthesis of purine nucleotides, including the chemical synthesis of some of the intermediates involved. Another interest at this time was in the chemistry of 'active sulphate' (adenosine 3'-phosphate 5'-sulphatophosphate), and the synthesis of this extremely labile molecule was reported in 1957.

In the 1960's, Baddiley and Buchanan turned their attention increasingly towards the structures of Pneumococcal antigens, and particularly to those type-specific capsular polymers which contain ribitol phosphate residues within the repeating unit, and thus have some features in common with the ribitol teichoic acids. Their work in this area led to the successful determination of the primary structures of the polymers from a number of different serotypes.

Alongside this large volume of collaborative work with Baddiley, Grant Bucha-

nan also carried out extensive studies of the chemistry of carbohydrate epoxides, an area that had first attracted his attention in the early 1950's. Grant's first foray into this area involved a study which he carried out himself on derivatives of 3,4-anhydrogalactopyranose, demonstrating the ease with which such compounds can isomerise to 2,3-anhydrogulopyranose systems. Later, in association with a series of able co-workers, a number of other significant advances were reported to help clarify the area of epoxide migration in carbohydrate systems, and also to identify and study cases in which neighbouring-group participation occurred in the ring-opening of acetoxypoxides. In addition to the original papers describing these studies, written with Buchanan's characteristic care and thoroughness, it is perhaps appropriate to note an excellent and much-cited review, co-authored with H. Z. Sable and published in 1972, which surveyed with great clarity the factors involved in the stereoselectivity of epoxide cleavages both in carbohydrates and other systems.

The quality of Grant Buchanan's work was recognised by his promotion to Senior Lecturer in 1962, and his appointment to a Readership in 1965. A year later he was awarded the degree of Sc.D. by Cambridge University, and, in 1969, Grant was invited to return to Scotland to take up the newly created Chair of Organic Chemistry at Heriot-Watt University in Edinburgh.

Heriot-Watt was an institution that had only acquired University status three years earlier, and one of Grant Buchanan's major responsibilities was to help build up the research activities of the Chemistry Department. A considerable impetus in this was given in 1973 by the move of the Department from its rather antiquated premises in the centre of Edinburgh to brand-new laboratories on the Riccarton Campus just to the west of the city. Although some work on sugar epoxides was continued at Heriot-Watt, Grant Buchanan also embarked on a new major line of research directed towards the synthesis of *C*-nucleoside antibiotics, the structures of which were becoming known in the late sixties. Buchanan's approach involved the intermediacy of glycosylalkynes, and this programme of research led over the years to more than twenty full papers describing syntheses of most of the naturally occurring *C*-nucleoside antibiotics and a range of analogues. Alongside the synthetic work, studies were also carried out on the biosynthesis of *C*-nucleoside antibiotics, which permitted the establishment of the principal biosynthetic building blocks, and some insight into the mechanism of their linkage. Other topics which have attracted Grant Buchanan's attention in recent years have included the structure and stereochemistry of carbohydrate acetals, where the application of ^{13}C -n.m.r. techniques has proved particularly helpful, and the use of carbohydrates as chiral synthons, with a particular emphasis on the synthesis of hydroxylated pyrrolidine and pyrrolizidine alkaloids.

Grant has been active in Professional affairs; he has served on the Council of the Royal Society of Chemistry (RSC) as both a Scottish Regional Member and as a National Member, and acted as Chairman of the Carbohydrate Discussion Group of the RSC, 1972–74; he was a Council Member of the Royal Society of Edinburgh for 3 years, having been elected to the Fellowship of the Society in 1972; he is currently the U.K. Representative to the International Carbohydrate Organisation and has recently

finished a two-year period as President of the European Carbohydrate Organisation. He has also served Heriot-Watt University in many capacities, not least as the head of the Chemistry Department from 1987.

Although Grant will retire from his Chair at Heriot-Watt at the end of September, his retirement will certainly not signify an end to his involvement in carbohydrate chemistry, since he will shortly be taking over from Allan Foster as one of the British editors of *Carbohydrate Research*.

Grant Buchanan's only serious vice – or at least the only one known to his colleagues at Heriot-Watt – is his particularly Scottish addiction to that pastime which Mark Twain described as 'a good walk spoiled'. There are Clubs for those so afflicted at both Heriot-Watt and Newcastle Universities, and Grant has been very actively involved in both organisations. Indeed, one of the first things he did at Heriot-Watt was to instigate an annual Heriot-Watt – Newcastle golf match which this year celebrates its 21st anniversary, and which will undoubtedly live on as a happy reminder of his activities in both Universities. Surely all this many friends and colleagues throughout the world will wish Grant a long and happy retirement, and hope that he and Sheila keep well out of the rough for many years to come.

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