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Foreword

The present thematic issue *Bacterial Antigens and Vaccines* follows a thematic issue of *Carbohydrate Research* on a similar subject entitled *Microbial Polysaccharides*, which was released in 1992 under the editorship of Professor Haralambos Parolis (Grahamstown, South Africa) and Professor Stephen G. Wilkinson (Hull, UK). The issue comprised 29 articles covering mainly structure and to some extent physicochemical aspects of bacterial glycans. New findings on monosaccharides, expression of the same polysaccharide in different forms (enterobacterial common antigen), lipopolysaccharides with acidic O-chains, and the elusive 3-deoxyoctulosonic acid (Kdo) were things that caught the attention of the editors in the foreword. It was speculated that future research prospects would continue structural studies with some reinvestigations of old proposals. Bioengineering, molecular modelling and epitope identification using NMR spectroscopy were other things that were thought of as imminent. In view of what has happened in the last decade, it is fascinating to see how difficult it was to envisage, even if genetics was on the way up, the explosion of research that has been made relating to molecular biology and to realise the benefit of the insights of polysaccharide biosynthesis.

In this special issue, an attempt is made to cover a broad range of scientific activities in the following fields: (i) Structure, including methodology; (ii) Conformation, physical and physico-chemical characterisation; (iii) Immunochemistry and vaccines; (iv) Synthesis and properties of antigens and neoglycoconjugates and; (v) Biosynthesis of bacterial antigens. This has been most successful with an impressive collection of 29 articles, including 10 **Perspective/Review** papers.

Structure is well represented by a number of regular and perspective/review articles covering lipopolysaccharides, capsular and extracellular polysaccharides, teichoic acids and glycopeptides. The techniques used are to some extent the same as ten years ago with different chemical reactions and 1D and 2D NMR spectroscopy, development of the latter has taken advantage of the availability of higher magnet fields and the setting of numerous new experiments. Mass spectrometry has changed most dramatically in the period, from a modest use of fast-atom bombardment MS to a variety of soft ionisation methods, like electrospray ionisation and laser desorption/ionisation MS including MS/MS, which can be applied to non-derivatised biomolecules. In earlier works, some components were overlooked but this rarely occurs now when MS is widely used. Elaboration of a new approach based on strong alkaline degradation of a lipopolysaccharide, followed by high-performance anion-exchange chromatography, has also enabled impressive progress towards the elucidation of the core oligosaccharide structures in a variety of bacteria.

The conformational aspect is represented in the present thematic issue by two Perspective/Review contributions on **biophysical characterisation**. Both demonstrate that this research has taken a step towards new levels of sophistication, including characterisation of single polysaccharide molecules by atomic force microscopy with the ultimate aim of understanding their involvement in biological processes. Chemical and physico-chemical studies of natural and modified exopolysaccharides, e.g. those with an increasing charge density, aim at finding or designing polymers with specific properties and may extend industrial applications of polysaccharides.

Three Perspective/Review articles are devoted to **immune response** to polysaccharides, including those having a peculiar structural feature like zwitterionic polymers, and the immunologic challenges of making polysaccharide-based vaccines. These articles clearly indicate the major achievements in immunology with detailed insights in cytokine induction and cell differentiation, which are important steps towards the construction and extended use of new polysaccharide vaccines. Immunochemical studies of carbohydrate antigens of medically important bacteria could benefit the serodiagnostics of infectious diseases.

Several regular articles on the **synthesis** of bacterial antigens highlight the important status of the field. It is now possible to synthesize almost any conjugate of almost any oligosaccharide in high-yielding reactions. The properties of synthetic neoglycoconjugates and conjugate vaccines can then be tested, e.g., in animal models. The synthetic approach is also useful for studying the biosynthetic pathways of bacterial carbohydrates.

Another three Perspective/Reviews in this issue cover the area of **biosynthesis**. Intensive studies of the **genes and their products** involved in the assembly of oligosaccharides, polymerisation and transfer of the polysaccharide chains provide detailed knowledge of most steps that comprise the biosynthetic machinery of bacterial

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polysaccharides. The recent realisation that lipopolysaccharides and capsular polysaccharides are synthesised in a similar manner is also reviewed. Genetic manipulations is proving to be a powerful tool for understanding the biological role of bacterial glycoconjugates.

We prefer to be cautious about the future but not much imagination is required to predict that instrumental improvements in structural studies will continue. For instance, maybe mass spectrometric peaks will be accompanied by an elemental composition and NMR databases will be used together with automatic tracing of spin systems to deliver a suggested structure. Introduction of new reactions and new chemicals in both analysis and synthesis of complex carbohydrates is highly probable. Certainly, molecular biology will continue to have a great impact on research over the next ten to fifteen years. Already interdisciplinary research is flourishing but this should be even more important in the future. The Editors of a future thematic issue with a similar content will certainly know how correct or incorrect these predictions are.

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