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Book review

Enzymatic Degradation of Insoluble Carbohydrates, Edited by John H. Saddler and Michael H. Penner (ACS Symposium Series 618), American Chemical Society, 1996. ISBN 0-8412-3341-1, 374 pp. Cloth, $91.95.

Most biomass, on a weight basis, is insoluble carbohydrate, and therefore enzymic degradation of insoluble carbohydrates is intrinsically important in the scheme of things. Controlled use of such reactions in the processing of polysaccharide materials is already of enormous economic importance, and this importance can only increase as restrictions on energy and chemical use become more stringent. Not least, moreover, the systems present the fascinating intellectual puzzle of how soluble enzymes can hydrolyse totally insoluble substrates. The present book arises from a symposium at the March 1994 American Chemical Society meeting in San Diego, and contains papers ranging from straightforward enzyme mechanism studies, through a couple of newly revealed enzyme X-ray structures, to biopulping and bleaching studies of direct practical relevance.

The submitted papers are largely from North American laboratories (possibly a consequence of the symposium organizers only offering to pay registration at the meeting!), and this reduces the value of the book as a 'snapshot' of the field in the spring of 1994. Thus, two X-ray crystal structure papers concern themselves with βGlcNAc-cleaving enzymes (B.W. Matthews on T4 lysozyme and J.D. Robertus on an endo-chitinase), but the reader would be unaware that a Dutch group was establishing that such enzymes worked by amide group participation (as any well-informed organic chemist in the early 1960's would have guessed they would). Stabilised glycosyl cations as glycosyl–enzyme intermediates, indeed, were at the time of the meeting all set to join the high-energy intermediate in oxidative phosphorylation in the junkyard of discarded enzymological concepts.

Two other X-ray structures were revealed at the meeting — an inverting endoglucanase from *Thermomonspora fusca* (by D.B. Wilson) and (at last!) the β-galactosidase from *Escherichia coli* (by B.W. Matthews) — although the latter, of course, does not have an insoluble substrate. Again, though, reading this book one would be completely unaware of the role played by X-ray crystallographic work in Uppsala, Paris, Reading, and York in producing definitive crystal structures of polysaccharide-degrading enzymes.

It is the same story with analysis of gene-sequences: there are two nice papers by N.R. Gilkes' group in Vancouver: one on cellulose binding domains, and the other on the cellobiohydrolases of *Cellulomonas fimi*. Where, though, is the sequence work from Espoo, Newcastle, Norwich, and, above all, the analyses from the Mecca of such work, Grenoble? On the mechanistic side, there are good contributions from E.J. Hehre (a review of his elegant work in discovering the many 'wrong' reactions catalysed by glycosidases) and from B. Nidetzky (a careful and well-thought out study of synergism by *Trichoderma reesei* cellulase components).

One of the strengths of the book is its bringing together good (if ethnocentrically selected) academic work with more applied contributions. There are two papers on xylanase bleaching of pulps, and various studies on the production of ethanol from biomass. Thermodynamics, though, would suggest a bright future for the use of enzymes in the pulp and paper industry and a restricted one for the production of ethanol from biomass. The dissolution of lignocellulose is thermodynamically favoured, yet the manufacture of paper involves the input of vast amounts of energy to bring about selectively changes which are thermodynamically downhill anyway. In principle, then, application of enzymes to papermaking is merely a question of finding the right one(s). The production of ethanol as a biofuel, though, suffers from the fundamental thermodynamic problems that ethanol is

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produced in dilute aqueous solution, and that modern agriculture is very energy intensive. It therefore seems that ethanol production from biomass only has a future when the feedstock is waste with negative value, such as cereal straw or domestic waste (which in the US at least is largely paper). An article on the economics of biomass-to-ethanol conversions by C.E. Wyman (full of graphs with no experimental points on them, which merely illustrate his assumptions), though, does not inspire confidence.

On balance, then, this book would represent a useful addition to the libraries of a wide range of institutions concerned with polysaccharides in one form or another, but is not something that individuals will rush to acquire.

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