Protein phosphorylation

Protein Phosphorylation. By M. Weller. Pp. 557. (Academic/Pion: London, 1979.) £29.

ALTHOUGH proteins such as casein and phosvitin have been known for many years to contain covalently bound phosphorus, it is only since the discovery of enzyme regulation by phosphorylation-dephosphorylation in 1956 by Krebs and Fischer, and the discovery of cyclic AMP-dependent protein kinase in 1968 by Walsh, Perkins and Krebs that interest in protein phosphorylation has increased dramatically. The number of enzymes known to be regulated by phosphorylation-dephosphorylation has increased from 4 in 1969 to about 25 today, and the number of phosphoproteins (as opposed to enzymes) that have been identified exceeds 100. These include such familiar proteins as fibrinogen, ovalbumin and pepsin, in which the role of phosphorylation is still unknown.

The past five years have established protein phosphorylation as the major general mechanism by which intracellular events in mammalian tissues are controlled by external physiological stimuli and research in this area may well account for 5–10% of current biochemical and pharmacological research. Protein phosphorylation is not only implicated in enzyme regulation, but in the control of secretion, ion transport, protein turnover, chromosome condensation and viral transformation. Protein-bound phosphate also plays an important role in the binding of divalent cations such as iron and calcium, and in bone formation. Furthermore, many enzymes form phosphorylated reaction intermediates as part of their catalytic mechanism. Six different amino acid side-chains (serine, threonine, histidine, lysine, glutamic acid and aspartic acid) are known to be phosphorylated.

Dr Weller is to be congratulated on being the first person to attempt the monumental task of writing a comprehensive book on all these different aspects of protein phosphorylation. The book is readable, very comprehensive in its subject matter and remarkably free of gross factual errors and printing mistakes. It comprises 13 chapters and covers work published up to about the beginning of 1977. Nearly 3,600 references are listed at the end of the book.

As always the major problem of writing a book on a topic that is progressing rapidly, is that large sections are already out of date on the day of publication. Indeed, after reading this book one can see how much progress has taken place in some areas over the past two or three years. The chapters dealing with cyclic AMP- and cyclic GMP-dependent protein kinases and the molecular specificity of these enzymes is already well out of date. The sections on enzymes such as pyruvate kinase, pyruvate dehydrogenase, acetyl-CoA carboxylase and initiation factors of protein synthesis which merit only a few lines in the book, would have to be expanded considerably today. Unfortunately the calcium dependent regulator protein story, which has revolutionised our understanding of the role of calcium in cellular control, and the interrelationship between cyclic AMP and calcium ions, broke just too late to get included. Naturally, enzyme systems discovered since this book was written, such as those involved in triglyceride, steroid, neurotransmitter and hormone synthesis are not included. Perhaps the major criticism that could be levelled at the book is that it is too much a catalogue of facts, and more could have been done to relate protein phosphorylation to the integrated metabolism of the whole cell. On the other hand, chapters dealing with topics that are no longer such active research areas, such as the caseins and phosvitins, will remain complete and accurate accounts of work in these areas for many years.

However, there is no doubt in my mind that this book is a remarkable achievement and that it is an extremely valuable background reference book for all people engaged in research in this area.

Philip Cohen

Philip Cohen is Reader in Biochemistry at the University of Dundee, UK.

Sensory mechanisms of the spinal cord

Sensory Mechanisms of the Spinal Cord. By W.D. Willis and R.E. Coggeshall. Pp. 485. (Plenum: New York, 1978.) $35. Available in the UK, Africa and the Middle East from Wiley (Chichester, UK) at £20.

THIS book will bring some coherence and stability to a confused subject. The confusion is partly inherent in the subject itself: inevitably the details of physiological mechanism, and, for the most part, micro-anatomical structure, come from experiments on a variety of higher animals, and any relevance to sensory mechanisms in man has to be established with the greatest caution. This kind of experimental evidence has appeared explosively in the past 15 years or so and the degree of caution has left much to be desired. So, although this is a detailed and wide-ranging monograph, it is a pleasure to find that it begins with a cautionary list of the types of general theory which have been advanced at various stages to bridge this gap and points out where these have been flawed by experimental error, unjustified assumptions, or plain mental confusion. The various 'dual' theories about somatic sensation are examined in this way and all found wanting. And an elementary but important semantic point is made that the word "modality" in sensation is a subjective and not objective term — one which defines quality in what we feel, and not, as many continue to treat it to the great confusion of others, a term describing an instrumentally measurable attribute of a stimulus. Similarly the book ends with a serious attempt to define, where evidence allows it, the sense-organs, tracts and nuclei which form the various channels on which the brain depends for its information in different kinds (or modalities) of sensory experience.

The main bulk of the book is concerned with categorising and summarising recent evidence. Enough is said about sense-organs to form a sound basis for what follows; but the main detailed subject-matter is the anatomy and physiology of the sensory mechanisms of the spinal cord and medulla, that is, in general terms, the early stages of synaptic processing of incoming information and its channelling into a variety of new specialised paths. This is a field in which the authors and their close colleagues have a large personal experience and have made important contributions. The terminology and specialised techniques are sufficiently explained to make this quite easy reading. A good test of a comprehensive text like this is to use it. I used it to answer a variety of fairly esoteric questions to which I did not have a definitive answer and found its layout conducive to doing this quickly. The chapter titles and subheadings are reliable. The summaries are particularly helpful: each section has a short italicised summary and each chapter a set of concise conclusions. The bibliography is excellent.

The subject is advancing in full spate. This book is undoubtedly the best available text, indeed the only one of the present period, and it covers material published up to and including 1977. The form of the book is such as to allow updating and it is very much to be hoped that this will be done in due course. It is an expensive book for students, who would find the first and last chapters by themselves an excellent introduction to a subject which is potentially confusing and usually poorly dealt with in the general run of textbooks. The bulk of the book, however, is for reference or for the worker in the field. As such it is very much to be welcomed and not overpriced.

George Gordon

George Gordon is Reader in Sensory Physiology at the University of Oxford, and Research Fellow, Brasenose College, Oxford, UK.