see how you behave when times get rough, when the money runs out. And anyway, tell me please, why should I trust you and believe that you are being truthful to me?" I don't think Bronowski would convince such a sceptic, who would of course be delighted by the revelations of Watson's *The Double Helix*, and also by some of the specious pleas made by scientists in recent years when the money has been running out. Nevertheless, those who practice science will recognise that much of what Bronowski says is right, though I think it has to be said modestly and quietly, for a big mouth never sounds truthful.

These are interesting lectures and they are eminently enjoyable to read, with a good story or 'bon mot' on every page. Because they are so light and readable, the true value of Bronowski's thoughts and speculations may easily be underestimated. □

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Eye movement during vision

Movements of the Eyes. By R. H. S. Carpenter. Pp. 420 (Pion/Academic: London, 1978.) £13.50; $27.

A MOMENT'S thought makes it clear that we collect sense data by active exploration of the world with our receptive surfaces, including the retinas of the eyes; the resulting relationships between the movements of the eyes and visual perception presents fascinating and formidable problems. Yet the movements themselves are particularly simple ones, as they engage a system of constant inertia, the eyeball and its muscles; eye movements need not involve the postural adjustments required by limb movement and are confined to rotations without translation. Thus, they ought to offer an ideal system on which to study many principles of the control of movement.

Dr Carpenter's book deals with the whole subject of eye movements, their control and their relationship to vision, and does it very well. The advantages for the research worker of its comprehensiveness, may, unfortunately, deter the medical or biological undergraduate; it is not a book which can quickly be scanned to provide a superficial view.

The first of three sections describes the types of eye movement found in man; there are six: the compensatory vestibulo-ocular responses which keep the image steady on the retina, tracking movements, saccades (used to change fixation from one object to another), vergence movements (which train the two eyes on the same target), and miniature eye movements (which may be the results of 'noise' in the control system but without which the stabilised image rapidly fades from perception).

The second part contains a particularly clear and comprehensive account of the static and dynamic properties of the globe and its muscles, which together form a highly damped system the force/displacement properties of which are remarkably linear, and ends with descriptions of the afferent and efferent connections of the oculomotor system. The final section deals with the relationship of eye movements to visual sensation and with models of the control systems for the various kinds of movements.

The first of two appendices is a useful summary of techniques of measuring eye movements; the second is a brief introduction to linear systems analysis. There is a good deal of emphasis on linear systems analysis throughout the book and Dr Carpenter has succeeded in his declared intention of presenting this in a way which should not alarm the non-mathematician. The mathematical appendix deals with a surprisingly large amount of material; surprisingly large, as it contains not a single differential equation. Although it will allow the uninitiated to follow this book, which relies on the 'differential operator' and eschews the Laplace representation, I fear that it will not equip him to cope with most of the original papers which do neither.

In addition to describing how elegant models can be built to describe the behaviour of the control systems, Dr Carpenter deals very fairly with the major problem of identifying, within the complexity of the nervous system, the physical mechanisms which may populate the black boxes; it is not surprising that the results are not very satisfying when the neural mechanism of even such a fundamental component as the integrator required by all models is elusive.

One may be forced to echo the final conclusion that "sadly, . . . nothing in the brain is as simple as it seems". But it is also true that we now have a much better account both of what we know, and of what we don't know, about the oculomotor system. For this we are in Dr Carpenter's debt; his book will be useful to all who are interested in control of movement or in vision.

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Computer software

Problems, Programs, Processing, Results: Software Techniques for Sci-Tech Programs. By P. Quittner. Pp.381. (Adam Hilger: Bristol, Academiai Kiado: Budapest, 1978.) £13.50.

THE author's intention, as expressed in the preface of this ambitious book, is to provide information about the workings of computer systems so that users may exploit available facilities more efficiently. Unfortunately, the title is somewhat misleading, as it implies an exposition of methods for designing and writing computational software; whereas by far the largest part is devoted to machine architecture, systems software, operating systems and data organisation.

Spot checks on how scientists use computers show that many expensive resources are squandered through clumsy programming. Of course, scientists are concerned with obtaining results quickly not with winning Nobel prizes for elegant software. However, it is surprising how a little knowledge of what happens to programs as they go through the machine can not only improve efficiency but also make the programmer's life easier.

This book will be of value to those seeking such knowledge. It covers a formidable number of topics in a clear and well-organised manner, although there is some imbalance in the depth of treatment given to some areas at the expense of others. It is doubtful, for example, whether a complete table of machine instructions for the IBM 370/145 should be included in a general book when there is no mention of structured software design concepts.

The breadth of the work may be judged from the fact that its 380 pages cover languages, assemblers, compilers, loaders, program testing, filing schemes, database management and operating systems. Specialist computer scientists may find its treatment of individual subjects too concise, except as introductory material and a stimulus to further reading for which a comprehensive bibliography is provided.

The book was written by a Hungarian with a refreshingly lucid command of English and is a welcome example of a textbook published as a joint venture between East and West.

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