

"informational" causality as something qualitatively distinct from physical causality, coexisting with the latter and just as efficacious. Roughly speaking, whereas in classical physics the determination of force by force requires a flow of energy, from the standpoint of information theory the determination of form by form requires a flow of information. The two are so different that a flow of information from A to B may require flow of energy from B to A; yet they are totally interdependent and complementary, the one process being embodied in the other. Here we have an irreducible duality, yet no need for dualist interactionism.

If the facts of our conscious experience are related to the physical events in our brains as control by information-flow is related to the physical events that embody it, this would allow (*inter alia*) that sensations can be categorically distinct from and not identical with brain events, that mental activity can efficaciously determine the form of bodily behaviour, that talk about persons is not analysable as (solely) talk about bodies and their parts, and that it is logically possible for a person to exist apart from his present embodiment. It would safeguard the substantial (albeit multidimensional) unity of the human being as we know it, without incurring the scientific and philosophical costs of dualist interactionism. It would allow recognition in human (and animal) nature of a "duality" that has no need of "dualism" in the sense of a "two-part" thought model. (Is the evaluator a "part" separate from the physical works of a thermostat? Is a flame a "part" separate from the gas/air mixture in a burner?)

To call X "part" of Y implies a relation such that a boundary of separation can be drawn between them. Nothing in Swinburne's argument (though we have here only inadequately sampled it) requires or justifies such a step. Minds are not mere computer programs; but the distinction between the equation being solved by a computer (which determines the form of its behaviour), and the physical hardware, points to a kind of conceptual separation quite as radical as that between two "substances", yet one which would not justify any talk of the equation as a separate "part" except in a Pickwickian sense. In this direction, perhaps, lies a more promising way forward? □

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• *Nature's* Autumn Books Supplement appears in the issue of 13 November, with contributions from (among others) Philip Kitcher, Lewis Thomas, D.J. Weatherall, Martin J. Klein, Joseph H. Taylor and John C. Marshall. The books reviewed include *The Blind Watchmaker*, *Was Einstein Right?*, *The Harvard Guide to Influential Books and Islands*.

Singular advantage

Clive Ellory

Transport and Diffusion Across Cell Membranes. By Wilfred D. Stein. *Academic:1986. Pp.685. Hbk \$79.50, £67; pbk \$49.95, £42.50.*

TWENTY years on from the first edition, the appearance of a new version of Wilfred Stein's book counts as quite an event. Single-author scientific works are losing out to multi-author volumes, and are now an endangered species, but the present book has all the traditional hallmarks of true authorship — enthusiasm, lucidity and a certain bias or even eccentricity in the selection and treatment of some topics. Stein has enlisted the aid of Bill Lieb for the excellent chapter on simple diffusion across membranes, but otherwise he has taken on the mammoth task of treating membrane transport single-handedly and singlemindedly.

Though there is nothing new in it, the usual introduction to membrane structure and function is sound, while the methodology section is brief but informative. The kinetic approach to behaviour of channels is original and leads directly into the comparison with carriers and what Stein still calls "facilitated diffusion". Here the success of the kinetic analytical approach to a number of transport systems is demonstrated in detail, with examples from glucose, nucleoside, choline and anion transport.

The complexity of the material increases in the fifth chapter, where co-transport systems are considered. As the author admits, it is the topic he found hardest to summarize and it is inevitable that individual readers will have their own list of omissions. Personally I found the lack of any treatment of the Na⁺/H⁺ exchanger or Na-K-Cl co-transport system (apart from some eccentric references in the table of data) disappointing in view of

their increasing importance in cell physiology. Even the title of this chapter, which refers to the co-transport of two substrates, is misleading because examples of systems carrying three substrates are analysed. The ultimate level of active transport is reached in the final chapter, where nearly 100 pages are devoted to the sodium pump. The enormous literature and byzantine complexities of this system are skilfully summarized and annotated; this part of the book contrasts markedly to recent reviews on the subject, which tend towards the catalogue approach, and it should provide a good source for those seeking explanation and elucidation of mechanisms. Other ATPases are given a less comprehensive treatment. F₁F₀-ATPases are dealt with sketchily in 14 pages, principally to emphasize the differences with the phosphoenzyme ATPases.

Excellent features of the book are the comprehensive tables and the summaries, and the use of data and figures from original papers. One minor irritation is the poor quality of symbols in the reaction schemes throughout Chapter 6. Another, more serious one, is the index, which is not thorough enough. Inevitably, there are some errors; particularly surprising is the consistent definition of Tl as tellurium! As a member of one of the smallest and most obscure groups working in membrane transport, and specifically identified in the preface as a potentially aggrieved reader, I did not feel my subject (amino acid transport in red cells) had been mistreated. Those in other areas, however, might have a stronger case.

For all the provisos, this book will be essential reading for a large number of scientists. It deserves to be an enormous success. My final impression, having grown up scientifically with its predecessor, was one of slight anticlimax, but Stein's achievement in producing another classic is undeniable. □

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REASONS

Before the telescope — the old observatory of Beijing, equipped with instruments brought to China by the Jesuits in the late 1600s. The picture is taken from Of Stars and Men, the autobiography of Zdeněk Kopal, published by Adam Hilger. Price of the book is £29.50, \$59.