of minicalculators.

When Dr Ayres talks about technology he is on firm ground, but his knowledge of economics and political science unfortunately does not match his admirable determination to give these subjects a higher priority than technology as determinants of the future. However, towards the end of the book, in the last 75 pages, he no longer comments on familiar facts; instead he gives free rein to his imagination. He describes, in the form of fictitious brief press extracts, the way in which a world energy crisis might develop in the west, or a food crisis in the Third World. As a scenario for the possible political response to an oil shortage between 1981 and 1985, I found the 18 pages of 'press cuttings' far more convincing than any sophisticated computer print-out. Ayres cites precedents from past history for some of his speculations about future history, and he presents the reader with a spine-chilling but quite credible series of social reactions which might follow another embargo of oil from the Middle East.

Forecasters, writes Dr Ayres in his preface, "must be independent-minded and indifferent to outcomes". He may have started to write this book as a true-blue forecaster. He ends the book as an advocate. Perhaps that is the moral to be

got from the book: that the intervening chapters dispel indifference. It is as well they should, for what emerges from this book, despite its superficialities and its flimsy supporting evidence, is not superficial at all. It is that democratic institutions, "never deeply rooted in most countries, have already proved to be pretty much incapable of grappling with problems for which all the solutions are painful". This, in my view, is a more imminent and serious danger than the danger of nuclear war. And an insidious danger, too, for there is no external enemy to be defeated: the enemy is within and invisible. President Carter asked the American people to regard the energy crisis as the "moral equivalent of war". But this is to ask a nation to adapt itself *in anticipation* of an environmental change, not — as happens with organisms other than man — as a *response* to the change after it has occurred. The American people have not responded. The sixty four dollar question is: will communities of people respond in anticipation in a way that communities of animals would not? We may not have to wait long now for an answer. □

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Perceptual phenomena

Handbook of Sensory Physiology. Vol. VIII: Perception. Edited by R. Held, H. W. Leibowitz and H. L. Teuber. (Springer: Berlin, Heidelberg and New York, 1978.) DM240; \$120.

OUR knowledge of perception has advanced in bursts. The mid-nineteenth century saw the inauguration of psychophysics, the doctrine of specific nerve energies, the foundation of colour vision, the discovery of the horopter, and the remarkable insights of Helmholtz. Between 1912 and the early 1930s, the discoveries of the Gestalt psychologists posed a whole new set of problems.

After a period of comparative quiescence, the modern era began in the mid-1950s. Since then, thanks to the development of many new techniques and the ingenious refinement of old ones, a wealth of new phenomena has been uncovered. The use of microelectrodes to record from single cells has revealed much about the amazingly systematic wiring that underlies the early stages of visual processing, and has made it possible to explain at least some psychophysical results in terms of known neurophysiological mechanisms. Thus, the dispute between Helmholtz and Hering

about whether colour vision was achieved by a three colour system or by two pairs of opponent colours has been resolved: in the retina there are three different cone pigments, but more centrally hue is recoded into two mechanisms each based on opponent colours. Many other psychophysical phenomena, for example, those connected with visual acuity, stereoscopic vision and the perception of motion, also fit in with recent physiological findings, though their detailed interpretation is often still in dispute. We are, for example, still uncertain of the exact physiological correlates of the after-effects of prolonged inspection of motion or of a tilted line: some argue for a passive process of neuronal adaptation, others for a more active inhibitory mechanism.

Moreover, much recent work has served only to emphasise the extreme complexity and subtlety of perceptual mechanisms without necessarily clarifying them. In speech perception we have little idea of how phonemes are extracted, though we do know that there are no separate segments of the speech sound wave that correspond in a one-to-one fashion with individual phonemes. Despite the mass of work undertaken using new physiological and psychological techniques to investigate perception in infants and young animals, we do not understand the subtle interplay between maturation and experience. Nor is there any secure explanation of visual masking — the obliteration of one stimulus by a second presented several milliseconds

later.

Perhaps even more dispiriting is the fact that many perceptual phenomena discovered long ago still await explanation: our understanding of the traditional visual illusions is no more secure today than at the end of the last century; nor do we know any more about the mechanisms that enable us to see an object as of the size it really is, despite the variations in the retinal size caused by changes in distance.

Only a man with the bravery and erudition of Hans-Lukas Teuber could have undertaken the task of editing a volume reviewing all the disparate results and theories that have emerged in recent years. He died before he had finished the job and it was left to the two co-editors whom he had co-opted to complete it. The finished product is worthy of his erudition. I can vividly recall him as he stood confronting one of his graduate students and saying in consternation, with that characteristic raise of his bushy eyebrows, "You mean you've never *heard* of Imaizikie?". The publication of Volume VIII of the *Handbook of Sensory Physiology* removes the wretched graduate student's last excuse for such ignorance. It provides a comprehensive source of references on the topics covered, but I feel it would not have met Luke Teuber's exacting standards in other ways. With the exception of his own contribution, the writing is for the most part pedestrian and fails to convey any sense of enthusiasm or excitement. Too many of the authors concentrate on listing facts or on attempting to resolve the many disagreements between recent results: they fail to place the findings they record in the context of what perception is all about. There are, of course, exceptions such as A. M. Liberman and M. Studdert-Kennedy who write on phonetic perception.

The vast number of phenomena recorded in this *Handbook* would have been easier to assimilate had more of the authors asked themselves what light the findings throw on the way in which perceptual tasks are carried out. Indeed, the one approach to the subject that is almost wholly missing from this volume is the theoretical study of precisely this question, that is, work on computational models of perception. Such research has revealed the role of the mechanisms discovered by microelectrode work: they provide a description of the retinal image that can in turn be manipulated to yield a representation of the external world.

In short, this *Handbook*, despite the solemnity of its approach, fails to make much sense of perception, and the boring parade of findings it presents is not worth the outrageous price asked by the publishers.

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