Book review

Advances in Cybernetics and Systems, Vols. 1, 2 and 3, edited by J. Rose, 1975; 1730 pages in all. (*Gordon and Breach*, £17·00, £29·10, £19·60 respectively)

Progress in Cybernetics and Systems Research, Vol. 1 by R. Trappl and F. R. Pichler, 1975; 358 pages. Vol. 2 by R. Trappl and F. de P. Hanika, 1975; 452 pages. (*John Wiley*, £12·50 and £16·85 respectively)

In founding the modern subject of cybernetics, the late Professor Norbert Wiener defined it as the science of control and communication in man, machine and animal. His essential objective was to bring together subjects which have conceptual and formal structures in common, but which hitherto had been thought of and pursued independently because people were blinded by the particular applications to which their particular studies were directed.

If control is to be effected well, it is necessary for the controller to have information about the state of the system. Control of this kind is known as closed-loop, and it evidently implies communication of information in each direction between the controller and the controlled system. From one point of view, the controller reacts to messages about its present state sent by the controlled system, and sends back new messages tending to bring the system closer to the desired state. From another view point, the action taken by the controller is determined by the current state information sent to it by the controlled system, so that this system in fact controls the controller. The more closely control loops are examined, the more the symmetry between the nominally controlling and controlled systems becomes apparent; like the laboratory rat who claimed to have conditioned the psychologist to feed him when he ran through the maze.

So cybernetics can usefully be thought of as the science of communicating systems interacting with each other. As such, it has enormous relevance in the modern world where techniques for dealing with one-way causal relationships are powerful and well developed, but in which we as yet lack equally effective mechanisms for dealing with interactions, particularly when these are multiloop. The instability of national and international economics, and the tendency of curative medicine to provoke overpopulation, are two examples which may serve to illustrate the difficulties we face when confronted with interaction. Of course the study of interacting systems is a very broad subject, and its very breadth gives rise to misunderstandings. Shortsighted outsiders tend to hark back to the pre-Wienerian obsession with the applications, and therefore to see cybernetics in terms of little bits of all sorts of other subjects, and particularly their own. For example, the Science Research Council is completely at sea in its administrative handling of cybernetics; at one time it actually placed it under production engineering, and now it is made to hover uneasily somewhere between computers and control. Equally myopic cybernetists emulate the blind fakirs by each clinging to a little bit of the subject and claiming it for the whole. The volumes here reviewed indicate the true diversity and unity of the subject.

The proceedings of the First International Congress of Cybernetics, held in London in 1969, were published in the 2-volume *Progress in Cybernetics*, and the present trilogy *Advances in Cybernetics and Systems* (ACS) is the successor recording the Congress held in Oxford in 1972. Since there is an international authorship comprising nearly two hundred contributors from all over the world, it goes without saying that there is a diversity of style, point of view, and content which permits a reviewer to do little more than list the principal topics, which are the application of cybernetics to automation, health, artificial intelligence and pattern recognition, computers, modelling, management and economic systems, and organic systems and learning. A stimulating opening essay by Professor F. H. George is addressed particularly to the problems, and indeed the definition, of machine intelligence. It does not emphasise the point of view, which the reviewer has found to be widespread, that intelligent behaviour by machine is tautologically unattainable, because we define intelligence in terms of what can be achieved by living systems but not by machines.

Progress in Cybernetics and Systems Research (PCSR) involves some hundred and twenty-four authors from many parts of the world, and again illustrates the diversity and maturity of the subject of cybernetics. The introductory article is contributed by Stafford Beer, and lays emphasis on the need for recursive structures in the successful organisation of a large and complex system. It is illustrated by reference to the author's experiences in attempting the cybernetic organisation of the economy of Chile, which he says has left him with confidence that things can be done the practicability of which he had previously doubted. Yet the Chilean experiment failed, and it would be to miss the point to see this failure as merely adventitious. On the contrary, the failure was a cybernetic one which took the form of a pragmatic demonstration that the system failed to provide the feedback necessary to preserve its own structure. A somewhat similar enterprise by the philosopher Plato in Syracuse met a similar fate. To emphasise this eventual failure is not however in any way to belittle Dr Beer's achievement in what is arguably the largest scale and best sustained experiment in cybernetic self-organisation of an economy yet carried out.

To readers of *The Computer Journal*, perhaps the most telling phrase of Dr Beer's is his plea that managements and governments should use a little human intelligence in deploying computers as logical engines which men like Leibnitz and Babbage intended them to be, and not as glorified accountancy machines. Cybernetics may light especially on his *cri de coeur* for real and effective communication of science, not the lucrative sale of pot boiling books nor the miraculous scientific fireworks delivered to an amazed public on television; cybernetics has suffered probably as much as any other subject except astronomy from both these hazards of popularisation. All can appreciate his call, echoing the intentions of Wiener, to heap all our science together for the common good.

The subject headings of PCSR include general systems, engineering, bio and neural cybernetics, socio-economic systems, cybernetics of cognition, learning and education, and cybernetics in organisation and management. One can indeed ask how such diverse topics as the Corti organ, electrical analogues, linear inequalities, art appreciation, scientific libraries and cattle farming can all belong in a single publication. However exactly the same doubts would be felt about the diversity of physics, from gyroscopes to quarks and back through transistors to the film-fountain effect, were it not that we have grown up to be used to seeing the unity behind this apparent diversity. We express it by referring to the underlying methodology and principles of physics, and to the quality which we can recognise as constituting 'good physics'. Cybernetics is similarly unified by the fundamental principles of feedback and interaction, and what is 'good cybernetics' often involves the recognition that the behaviour of a system can often be influenced more strongly by the feedback around it than by the obvious forward-path of information flow. This recognition resolves many paradoxes in human, social, ecological and other systems; send not to ask what a man has been told to do, but ask what is the effect on him of the courses of action he can choose.

Divers though their respective authorships are, there is yet a subtle difference in flavour between ACS and PCSR which readers may enjoy attempting to identify. In production, ACS is economically offset from typescript without righthand margin justification, but the sharp imaging makes for clarity. PCSR is more sumptuous, printed in two columns, again without justification. It has just the occasional lapse into non-English English or typesetting. Both publishers naturally claim their book as almost a necessity of intellectual life, and this is true in the sense that each volume will contain something of importance to almost everyone. It is likely however that the volumes will be consulted in libraries more often than privately owned, since the other side of the coin is that there is much in each text which will not interest an individual reader. Probably these volumes are best seen as a further substantial contribution to the well established international literature of cybernetics, a subject which has widespread recognition across the world from Russia to America, but has hitherto been unjustifiably neglected in Great Britain outside a few special centres for the subject.

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