

feelings and mechanics. In my view this is an obvious misunderstanding”.

As a result of all this confusion, Pavlov burdened himself with a series of verbal subterfuges which are now seen to make nonsense. Worse still, he fastened these upon his followers in the form of a terminology which hindered a whole generation of them from going forward to tackle the really interesting problems which he had the insight to see were awaiting them. The modern development of elaborate cybernetic mechanisms as analogical tools for the study of the higher nervous centres is a very important one and likely to be of great service. Psychologists in recent decades have tended more and more to neglect the old concern with thoughts, feelings and sensations and to suspect introspection. There are good historical and other reasons for this. But consideration of brain models and of Pavlov's concepts brings one back again to the fundamental question whether, if one is concerned to understand behaviour, one is following the best course when one neglects altogether, to quote Tustin⁴, the “one privileged access available to such immediate precedents and accompaniments of behaviour as thoughts and feelings, that are part of the complex of events of which behaviour is also a part”. The usual way of escape is to fall back on the precious word ‘complexity’ and to assume that, because of its complexity, the brain is conscious and that a machine elaborate enough to maintain an inner representation of the outer world may thereby be conscious. But, as Tustin says, this is no explanation. For to regard consciousness as an emergent does not merely fail to explain consciousness in terms of assumed elementary physical mechanisms; it assumes that it is inexplicable on that basis. This is the kind of fundamental theoretical difficulty which was the basis of Pavlov's confusion, as it is of many to-day. As Whitehead says, science must be continually criticizing its own foundations if it is not to be in danger of developing into a medley of *ad hoc* hypotheses.

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¹ Konorski, J., “Conditioned Reflexes and Neuron Organisation” (Cambridge, 1948).

² Holst, E. von, *Brit. J. Anim. Behav.*, 2, 89 (1954).

³ Agar, W. E., “A Contribution to the Theory of Living Organism” (Oxford, 1943).

⁴ Tustin, A., *Brit. J. Psychol.*, 44, 24 (1953).

remaining two are devoted to economics and future prospects.

The theory of control systems, which is the author's own field of research work, is introduced by a historical sketch of various automatic mechanisms from seventeenth-century pressure cookers to mid-twentieth-century naval gunnery. The development of the understanding of these various individual mechanisms into a fundamental science is brought out by discussing some of the famous theoretical personalities—Maxwell, Routh and Nyquist—who have contributed greatly to the theory of servomechanisms. The aim of this section is to bring out in non-technical language the concept of feedback. The essence of the section on production can be summed up in the two phrases ‘line production’ and ‘transfer machines’. These are methods established in the 1920's. Automatic computers are dealt with in Chapter 5, again on a historical basis. Pascal (1642), Leibniz (1673) and Babbage (1829) are given as the early forerunners who laid down the basic principles of the modern high-speed electronic counterparts. Sufficient emphasis is not given to the major developments by ingenious inventions of large-capacity storage of data with, at the same time, rapid access to any required piece of stored information. Analogue computers are also mentioned and incorrectly termed ‘simulators’ (p. 63). The reader is also left with the erroneous view (p. 73) that, in general, the analogue computer is much faster than the digital machine.

The chapter on economics is weak; only the factors affecting the installation of equipment are considered. The overall economy, including the treatment of labour redundancy, is not dealt with. On reaching the last chapter, on “Present Impact and Future Prospects”, one is disappointed to find that it does not deal with the book's provocative title but is devoted exclusively to the expansion of the feedback concept of the control engineer into other sciences such as physiology, biology, zoology, theory of economics, etc.

This is a very interesting and well-written book which does not demand any scientific knowledge of the reader. It is a great pity the contents are not covered by the title.

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AUTOMATIC CONTROL AND MACHINES

Automation

Friend or Foe? By R. H. Macmillan. Pp. viii + 100 + 8 plates. (Cambridge: At the University Press, 1956.) 8s. 6d. net.

THIS small book of approximately twenty-four thousand words is based on the author's series of B.B.C. broadcasts, on automatic control and automatic production, in the Third Programme. In the introduction the meaning of the word automation is described as automatic production and the striving for a fully automatic factory. From the rest of the book it becomes obvious that the only new discovery in the past decade in this field is the word automation itself. The three branches of engineering science which must combine to make automation possible—namely, automatic control or servomechanism theory, mechanization of production, and electronic digital computers—are dealt with in four of the six chapters of the book. The

ELECTRONICS IN PHYSICS AND ENGINEERING

Advances in Electronics and Electron Physics Edited by L. Marton. Vol. 7, 1955. Pp. x + 527. (New York: Academic Press, Inc.; London: Academic Books, Ltd., 1955.) 11.50 dollars.

THE seventh volume in this now well-established and excellent series of specialist review articles contains much the same blend of physical and engineering electronics as its predecessors; but there is a somewhat stronger emphasis on related solid-state phenomena. The contents consist of seven independent reports of advances in widely different branches, ranging from semiconductors to radio astronomy. The reports vary in length from forty to a hundred pages, and each includes a very extensive bibliography of well over a hundred references. The “Advances”, like the many other similar annual reviews of individual branches of science, fulfil a very important function in these days when the volume