NEWS AND VIEWS

Knowing How to Remember

It is not surprising that molecular biologists are making such heavy weather of the design of theories to account for memory. The problem is plainly one of extraordinary difficulty and it would be entirely unreasonable to hope that it will be rapidly solved. In the past few years, there has been some excitement about the possibility that RNA may somehow provide a means of storing information from one year to the next and for the whole duration of a person's lifetime. Indeed, since the importance of the nucleic acids in cell metabolism was first recognized, it has been clear that ringing the changes on the nucleotides in a long nucleic acid molecule is one of the best ways of obtaining the kind of storage capacity for information which it is supposed that human beings make use of in their ordinary life. But in spite of several series of experiments in which rats and other laboratory animals have been fed with RNA from other animals of the same species, and in spite of several reports that in the process it has been possible to transfer learning from one animal to another, the results are by no means conclusive enough to single out RNA as a repository of memory. Indeed, given the impermanence of RNA molecules in most kinds of cell metabolism this molecule is an unlikely long term store.

The frustrations of the RNA theory have in part been an explanation of how interest has turned, in the past few years, to the notion that memory may function along holographic principles. The way in which it is possible to reconstruct the three-dimensional image from a flat piece of photographic film, and the way in which the image may be reconstructed from only a small part of such a hologram, are altogether too suggestive of the way in which memory works to be ignored. One of the advantages of this view is that the storage of a single piece of information can be supposed to be distributed over a large part of the brain, which fits in nicely with the observation that damage to the brain can often leave memories intact. But, as several authors have pointed out, one problem is to account for the way in which the brain seems free from the problems of noise which beset holography. A number of ingenious ways in which this difficulty may be resolved were suggested some weeks ago by Willshaw *et al.* (*Nature*, **222**, 960; 1969) and there is obviously a lot of work to be done along these lines.

The ingenious suggestion by J. S. Griffith and H. R. Mahler (page 580) is another obvious candidate to be reckoned with. The notion is that DNA molecules in neurones function as repositories of memory. This certainly has the advantage that it accounts more than adequately for the storage capacity of the human brain and for the permanence of memory. To avoid the biochemical difficulty of requiring that DNA should be synthesized in neurones, Griffith and Mahler suggest that the distinction between DNA molecules which store information and those which do not consists of the methylation of particular cistrons in the molecule. One valuable feature of the model is that it accounts for the saturation of memory, and there are ways in which the storage of a complete set of information in a DNA molecule would help to determine the arrangement of synapses. Localization is still a problem but the freshness of this model should be a great stimulus to further speculation and experiment.

EXPERIMENTAL PSYCHOLOGY

Autonomic Learning

from a Correspondent

The nineteenth International Congress of Psychology attracted some 2,000 psychologists to University College, London, from July 27 to August 2.

One of the highlights of the conference occurred early in the week when N. E. Millar (Rockefeller University) summarized his work on learning by the autonomic nervous system and viscera. During the past two years, Miller and his co-workers have succeeded in breaking down some of the normal distinctions between the cerebro-spinal nervous system, thought to be the organ of sophisticated voluntary actions, and the more lowly involuntary autonomic nervous system. In appropriate circumstances responses of glands and viscera can be trained. So far Miller has succeeded by rewarding rats with avoidance of shock, with water when thirsty, or most often by reinforcing stimulation of the brain. In this way he has trained salivation, intestinal contractions, heart rate, blood pressure and urine formation. With each of these responses the control procedure was to use the same reward to train one group of rats to increase the response and another group to decrease it.

This achievement is clearly of considerable theoretical and practical interest. Although there are still problems in applying the procedure to humans because the best results with animals are obtained with curare, a beneficial medical result has already been achieved with a patient with chronic tachycardia.

D. E. Broadbent (MRC Applied Psychology Research Unit, Cambridge) expressed the opinion that many very interesting fundamental problems of experimental psychology have arisen out of the need to find solutions to applied problems. As a result of research on vigilance, attention and skill it is now a good deal more clear how equipment should be designed so that human operators can control processes and monitor complex displays of information. Experience in this field has been widely used in projects ranging from the American Apollo programme to the design of London Transport's new Victoria Line.

Research on the stages through which information passes in its preliminary analysis by the brain is one of the growing points of psychology. R. S. Nickerson